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REPORTS OF CHIEFS

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Section 73, paragraph 2:

The Annual report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

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# REPORT OF THE SECRETARY OF AGRICULTURE.

# REPORT OF THE SECRETARY OF AGRICULTURE.

WASHINGTON, D. C., *November 15, 1923.*

To the PRESIDENT:

It is a satisfaction to be able to record marked improvement in agriculture during the past year. Prices of many agricultural crops are higher. Cost of production has been lower, and there has been some reduction in prices of the things farmers buy.

In 1923 farmers planted 341,000,000 acres of the 14 principal crops. This was an increase of more than 2,000,000 acres over 1922. The production of these 14 crops is estimated to aggregate 265,000,000 tons, which is about the same as in 1922 and 11,000,000 tons greater than the 10-year average.

Taking the value of the 11 crops—corn, wheat, oats, barley, rye, buckwheat, flaxseed, potatoes, sweet potatoes, hay, and cotton—as of October 1, except in the case of corn (which is taken at the December future prices as recorded for the first 15 days of October), we find that this value was $5,289,000,000 for 1921, $5,711,000,000 for 1922, and $6,947,000,000 for 1923. In neither year does the sum indicated include the total value of farm crops grown, but for comparative purposes the values of these 11 crops for the years mentioned indicate the substantial increase in the money received by farmers in 1923 as compared with 1922 and 1921.

Not only will the total general farm income be considerably greater for the year 1923 but this income will buy relatively more of the things farmers need than for some years past. The purchasing power is greater. Hence farmers generally are better off both actually and relatively, and this is reflected in their increased purchases, which in turn has helped general business. The farm productive plant has seriously depreciated during the past six years, first because of war conditions and later because of forced economies. As the farm income increases, therefore, farmers will buy more and more freely of the things they need.

### THE CROPS OF THE YEAR.

The wheat crop for 1923 is estimated at 782,000,000 bushels, compared with 815,000,000 bushels in 1921 and 862,000,000 bushels in 1922. The quality of wheat this year is somewhat below the average, owing to weather conditions and the ravages of plant diseases.

The corn crop is estimated at 3,029,000,000 bushels, as compared with 3,069,000,000 bushels in 1921 and 2,891,000,000 in 1922. The quality of corn in some regions has been materially injured by early frosts.

The cotton crop gives promise of being a half million bales greater than that of last year, the October 25 estimate being 10,248,000 bales, compared with 7,954,000 bales in 1921 and 9,672,000 bales in 1922. The cotton acreage was larger this year than last, and the cotton production would have been appreciably above the October estimate had it not been for unfavorable weather and heavy rains, exceptional damage to grown bolls by the weevil, and the heaviest abandonment on record.

An estimate based upon the first nine months of the present year indicates a slight increase in the number of cattle and calves slaughtered, and that a total of perhaps 78,000,000 hogs will be slaughtered in 1923, compared with 62,000,000 in 1921 and 67,000,000 in 1922.

In some lines of production prices have been fairly satisfactory, while in other lines low prices have added to the accumulating financial difficulties of the farmers.

The farm price of wool is more than twice the pre-war level. The farm price of wool in August, 1921, was but 15.4 cents per pound and in September, 1923, was 37.1 cents. The reduction in the number of sheep, the diminution of stocks of wool and woolen goods during the post-war adjustment, and last, but not the least, the resumption of a protective tariff have stimulated prices of wool.

Cotton prices continue at a relatively high level. The farm price is now two and a quarter times the pre-war level. The huge surplus of cotton which was carried over at the end of the crop year, July 31, 1921, has been reduced to a point verging upon an actual shortage and the quantity carried into the new season was the smallest in a number of years. The world consumption of American cotton during the year (1922–23) was over 12,500,000 bales and American production was less than 10,000,000 bales. The present status of

the cotton farmer is not always fully understood. The planter is interested in the price and purchasing power of cotton per pound, but he is more interested in the returns per acre. The ravages of the boll weevil have reduced the production of cotton per acre sufficiently to discount to some extent the high prices paid for cotton. Elsewhere in this report reference is made to control measures of this pest. The purchasing power of cotton per acre, which is above the pre-war average, is a better index of the southern planters' economic condition than the present high price of cotton. Districts in the South with a fair yield are in a splendid condition. On the other hand, districts like southern Georgia, suffering severely from the boll weevil, are in dire straits.

The prices of dairy products did not suffer so much from the drastic deflation following the post-war period as did other farm products. Butter, cheese, and milk have sold at prices remunerative to farmers. Butter is now higher than the general price level. Cheap feed in western butter districts, and high prices and some curtailment of production in milk districts have enabled the dairy farmer to weather the storm with less adversity than those farmers producing commodities a part of which must be exported. Poultry and eggs have also continued on a fairly profitable basis.

Besides wool, cotton, chickens, and butter previously mentioned, beans, apples, broomcorn, cabbage, onions, cotton seed, and lambs are higher than the general price level.

Horses, rye, barley, timothy seed, oats, hogs, wheat, hay, veal calves, beef cattle, milk cows, corn, clover seed, buckwheat, sweet potatoes, flaxseed, and potatoes are still below the general price level, but many of these products have experienced appreciable advances in price this past year. Flax rose from $1.88 in 1922 to $2.12 in 1923. Oats rose from 34.5 cents to 38.6 cents. Hay from $10.58 to $12.42. Milk cows, $51.62 to $56.13. During no month of 1922 did veal calves sell for as much as in September, 1923.

Corn prices have had a very appreciable advance during the past year. The low receipts at primary markets and the low visible supply of corn have resulted in rising prices despite the large farm stocks and heavy production during the three years 1920–1922. Corn prices advanced from 61.6 cents for October, 1922, to 85.7 cents in 1923. If all corn could be sold at this price the corn farmer would find him-

self in a relatively fortunate position, but since it is the demand for corn to finish the large numbers of hogs in preparation for the market that creates the relative shortage of corn and makes this price possible, and since not over 20 per cent of the crop will be sold as corn, prices of hogs must always be considered in connection with prices of corn. The past year was characterized by enormous increases in hog production, marketing, and slaughter, and by large increases in domestic consumption and foreign trade in lard and pork.

The liquidation in the industry that followed the decline in the price of hogs reduced our hog population to a very low point, and this reduction was immediately followed by three bumper corn crops in succession. This resulted in a surplus of corn and a deficiency in hogs and the hog-corn ratio was the highest in many years. As usually occurs after a period of large corn crops, hog production was given a great impetus, and the marketing of hogs for the year ending June 30, 1923, exceeded that for the preceding year by more than 9,000,000 head. As a consequence, hog prices receded sharply and corn fed to hogs is now bringing lower prices than corn sold on the market.

### BAD WHEAT SITUATION.

The discouraging wheat situation is due in part to increased acreage in response to patriotic appeals and the extraordinary demands for wheat by the war administration. By similar appeals the war administration reduced bread consumption in the homes and took it off the restaurant table. This has definitely reduced the per capita consumption. The evil results of these policies continue. The world wheat production is too great in proportion to the restricted consumption. The great wheat producing areas in the United States, Canada, Argentina, and Australia increased their annual exports 336,000,000 bushels. At the present time the exports of wheat from these countries are more than twice their pre-war exports and more than compensate the former exports from Russia and the Danube Basin and the decreased Indian exports.

War has had a marked effect upon the bread grain consumption of some European countries as well as of the United States. The standard of living in some countries has been lowered and cheaper foods substituted for wheat. Wheat has been conserved by "long

milling," mixing, and by feeding less to livestock. The per capita consumption of wheat in the United Kingdom has remained remarkably constant during the last 14 years but declined slightly during the war. In France per capita wheat consumption, including seed, was reduced from an average of 9.3 bushels during the period 1909–1913 to an average of 7.4 bushels during the war period of 1914–1918. Since then the average has increased to 7.7 bushels. Milling restrictions requiring the mixing of from 8 to 10 per cent of substitutes with wheat flour are still in force. The per capita supply of bread grains has also been considerably below normal in Germany and Austria. Thus in selling their surplus wheat the farmers of the United States have to meet increasingly keen competition in a foreign market where the demand has declined.

### CATTLE AND SHEEP.

The 640-acres-grazing homestead act and tariff reduction on wool some years ago depleted the number of sheep on the ranges and stimulated cattle production. The pre-war price of range cattle was $6.74. In 1922 the price was $6.60. The war stimulation of the range-cattle industry and the consequent advance in cattle values led many producers of range cattle to overextend themselves and make large use of their credit, which was easy at that time. The shrink in values since, combined with unfavorable weather conditions in some sections, have resulted in severe financial losses. As a result throughout the range country liquidation has been and still is being forced, and large numbers of cattle, cows as well as steers, have been thrown on the market at ruinous prices. Loans on cows are being called and new loans on cows very generally refused. This forces too many cows on the market now and tends toward a shortage later.

On the other hand, cattle feeders who finish on grain for market have fared very well during the past year. Prior to the war cattle ranging in weight from 1,200 to 1,350 pounds were about 17 per cent above the price of range cattle. In 1922 cattle of this weight sold about 36 per cent above the price of range cattle. In 1922 good to prime cattle were about 50 per cent above the price of feeder steers, while in September, 1923, they ranged to about 70 per cent above. The high industrial activity has given a good market for good beef and has stimulated a demand for the higher grades of cattle which come finished from the feed lots of the Corn Belt.

## STATE OF AGRICULTURE IN GENERAL.

The general agricultural improvement noted is most gratifying to everybody and gives renewed hope to millions of farmers who have struggled against most distressing conditions. This does not warrant the assumption, however, that the state of agriculture in all sections is now satisfactory, viewed either from the standpoint of the farmer or from the standpoint of national interest. In many regions agriculture still is at a disadvantage. The adverse influences of which mention was made in my report of a year ago still exist, though less powerful than at that time. The ratio between prices of most farm products and prices of other commodities is still far out of line. Industrial wages continue at war-time levels and thus help to maintain high prices for most of the things the farmer buys. High freight rates still prevail, and, while not the cause of low farm prices, place one more additional burden upon the farmer which he can ill afford to pay in view of the prices he must take for his products; also they place him at a disadvantage with his foreign competitors in world markets in the case of those farm products which we export. Unfavorable exchange rates with European countries, together with financial difficulties in those countries which need our surplus, make it more difficult for them to buy, and our export outlet for farm commodities is narrowing. Aside from this difficulty, it is to be expected that as the countries of Europe get on their feet, they will strive to produce more of the things they need and buy less from us, and this must be considered in planning our own production. The costs of retail distribution of farm products are unreasonably large, thus enhancing the price to the consumer and depriving the farmer of the benefit of increased consumption which ought to follow lower prices which result from large production.

Studies by this department indicate that 42 per cent of the farmers feel that their financial difficulties are due to low prices of farm products; to high taxes, 17 per cent; high costs for farm labor, 11 per cent; high freight rates, 10 per cent; high interest, 10 per cent; reckless expenditures during boom period, 6 per cent; and too much credit, 4 per cent.

Too frequently persons who have not inquired into the matter express the opinion that the farmers' difficulties are due to reckless expenditures for land, speculative securities, and other purposes

during the flush years. The percentage who suffered in this way, however, does not seem to be very large. The farmers' troubles are due primarily to the low prices of their farm products and the high prices for the services and articles they must buy.

### TAXES AND INTEREST.

In addition to the handicaps just mentioned there is underlying this agricultural situation the fundamental factor of the lowered price level which has shrunk the purchasing power of the farmer's income. Economic justice would require that the price level during the years when the debtor is paying individual and public debts should be as high as when these debts were incurred, thus making it possible for him to meet his fixed payments of taxes, interest, and principal with about the quantity of labor or the products of labor required to meet them at the time the debts were incurred. This is not the case now with the farmer. It is not possible to adjust the price level with that nicety which will do justice to everyone, but in so far as it is possible it should be done. Our investigations lead us to estimate the property taxes and interest combined paid by agriculture in the year of 1920 at about $1,457,000,000; in 1921 at $1,684,000,000; and in 1922 at $1,749,000,000.

In 1920 practically the entire value of the wheat and tobacco crops, or about two-thirds of the wheat and cotton crops, were required to pay property taxes and interest charges. This was during the period of high prices and lagging charges for taxes and interest.

In 1921 property taxes and interest were equal to the entire value of the wheat, oats, potato, and tobacco crops. The wheat and cotton crops combined would pay but five-sixths of the taxes and interest. This was during the period of low prices and rising charges for taxes and interest.

In 1922 the value of the wheat, oats, and tobacco crops, and one-half of the potato crop, were required to pay taxes and interest. In that year although cotton was very high in price, taxes and interest charges were equivalent to the entire value of the cotton crop plus two-thirds of the wheat crop. Property taxes increased from $532,000,000 in 1920 to $797,000,000 in 1922.

Unfortunately reliable estimates of taxes and interest charges are not available for the pre-war years. It is estimated, however, that

property taxes alone in 1914 aggregated about $344,000,000, which was equivalent to less than two-fifths of the 1914 wheat crop, while in 1922 taxes totaled $797,000,000, which was approximately equivalent to the total value of the 1921 or the 1922 wheat crops. The wheat crop is approximately equal to the pre-war value, but taxes have more than doubled. It should be kept in mind that the increase in taxes is due to local and State governments, not Federal.

Under such a situation farmers who are out of debt can get along fairly well, but those who are heavily in debt, and especially those young farmers who have not become thoroughly established, are having great difficulty in meeting interest and principal on public and private debts.

It would seem to be distinctly in the public interest that the price level during these years when we are working out of war difficulties be maintained at from 60 to 70 per cent above the pre-war level. Just as sound money requires a gold basis so sound business requires an equitable and stable price level.

### RURAL POPULATION INFLUENCED.

The result of the conditions which have prevailed during these years of agricultural deflation is reflected in the steady drift from the farms to the towns. Our estimates indicate that the net change in population from the farm to the town in 1922 was around 1,200,000. This drift is taking place not alone in those sections where agricultural depression is being felt most keenly just now but throughout the country. This is illustrated in a number of ways. For example, 4.7 per cent of the habitable farmhouses were vacant in 1920; 5.7 per cent in 1921; and 7.3 per cent in 1922. A recent study indicates that in 1922 farmers occupied 86.3 per cent of the habitable farmhouses as compared with 88.4 per cent in 1921 and 89.7 per cent in 1920. Because of the scarcity of houses available for them nearer their work, many farmhouses within reasonable distances of cities are being occupied by people who work in the cities.

In Michigan a special survey made this summer covering a large number of farms indicates that fully 10 per cent of these farms were vacant, and about 13 per cent more were only partially worked. This survey also showed that there were also 16 per cent fewer workers

on the farms in Michigan than a year ago and that 91 per cent of those leaving the farms did so to better their financial condition, 6 per cent because of old age, and 3 per cent because of other causes.

During the year ending February, 1920, it is estimated that 22,000 workers net left the New York farms; in 1921, 24,000 net. For the year ending February, 1922, this number had decreased to 3,000, the explanation being that the unemployment in the cities during 1921 caused many persons to move to the farms. For the year ending February 1, 1923, this movement had swung back, and the net movement to the cities was 26,000. It is reasonable to believe that a similar movement from the farms to the cities is general throughout the country, although reliable figures such as have been quoted with reference to New York are not available for other States. Perhaps the movement has not been so large in some other States as in Michigan and New York, which are so highly industrial.

### FINANCIAL DIFFICULTIES.

This year the Department of Agriculture instituted an inquiry through both bankers and farmers as to the number of farm owners and farm tenants who lost their farms or property through foreclosure or voluntary relinquishment.

It was found that of the owner farmers in 15 corn and wheat producing States on an average over 4 per cent had lost their farms through foreclosure or bankruptcy, while nearly 4.5 per cent had turned over their farms to creditors without legal process, making a total of about 8.5 per cent who had lost their farms with or without legal proceedings. In addition, more than 15 per cent were in fact bankrupt, but were holding on through leniency of their creditors. Considered by groups of States, the percentage of owner farmers who lost their farms since 1920 was found to be as follows: For 5 east North Central States, nearly 6 per cent; for 7 west North Central States, over 9 per cent; and for 3 Mountain States, nearly 20 per cent. The percentage of tenants who lost their property ran materially higher.

The records of the Department of Justice indicate that in the pre-war years 5 per cent of all bankruptcy cases were farmers, but in 1922 it had grown to 14 per cent. In some of these States, where in pre-war years the farmers' bankruptcy cases represented about 7 per cent of all such cases, this percentage in 1922 had risen to nearly 30.

These losses have not been due to inefficiency on the part of the farmers. Practically all of them were incurred by men who had been doing fairly well until they entered the period of drastic deflation. Some few were caused by overexpansion in the purchase of land during the period of high prices. In general, however, the trouble has been due to the deflation in prices of farm products and the increased cost of production and of the necessaries farmers must buy.

### THE DRIFT TO THE CITIES.

This drift from the farms to the cities is due in part to inability to make a decent living on the farm and in part to the fact that the Nation has been willing to pay higher wages relatively for workers in the industries of various sorts than for workers who are producing food. As long as the unfavorable ratio between agriculture and urban occupations continues an abnormal movement from the farms is not only to be expected but desired. It is one of the ways by which normal balance between agriculture and industry in time may be restored.

From the national viewpoint, however, this movement is to be deplored both because of the conditions which seem to make it necessary and because it is draining from the country such a large percentage of the more intelligent and ambitious young farmers. Agriculture always produces a large surplus population, and under normal conditions feeds into the cities large numbers of the less intelligent, who because of this are not well adapted to modern farming, which requires intelligence of a high order, but are better off in the cities which provide them supervised work. It also sends many young men of superior intelligence who seek wider opportunities than exist in the country. In the past both classes have gone to the cities without detriment to either the urban centers or the open country, but conditions which have prevailed for the past three or four years have made drafts upon the best the country produces altogether heavier than is good for either the country or the Nation.

### DECLINE IN MORALE.

The Nation has suffered in another way. The drastic economies which have become necessary on the farms have greatly reduced farm standards of living. They have compelled overwork by the farmers, unaccustomed farm work by farm mothers, increased work

by children kept out of school—in too many cases the older children taken out for good. Continued disappointment on the part of all members of the family, worry and discouragement, added to privations, have resulted in the breaking up of many a home. Retrenchment in support of school and church and restricted recreation and public entertainment became necessary. The farm population of the Nation, although less than 30 per cent of the total, is carrying more than 35 per cent of the child population. The farm is charged with the duty of educating this excess of youth and turning it over to the cities at the producing age. During this period of depression both the children who are to remain on the farms and those who are to be turned over to the cities have been deprived to too great an extent of the spiritual and mental training which is so necessary to make them citizens of the right sort.

The Nation has suffered equally in depressed morale. There has been no satisfaction in the minds of the farmer or in the minds of the city dwellers over this agricultural depression. The farmer has no challenge to heroism. The farm wife has no glory in her sacrifice and disappointment and long days of toil. The result has been a social and political unrest which has not contributed to national welfare. The undeserved fate and the powerlessness to pull out of difficulties has lessened hope and developed an unrest which will be felt for a long time. The farmer does not wish to complain, but he is driven to it; and at the same time he resents the condition which makes it necessary to complain.

### IMPROVEMENT AND SOME REASONS FOR IT.

In speaking thus briefly of some of the adverse conditions, it is not with the purpose of painting a dismal picture but solely with the thought that a bad condition can not be corrected unless it is understood. As I said in the beginning, the agricultural situation to-day is very much better than a year ago, while the advance made over the terribly discouraging conditions which were precipitated in 1920 and reached the climax in 1921 is nothing short of remarkable. In general there has been steady improvement since the low point in 1921.

No small part of this improvement must be credited to wise legislation and to helpful administration. Agriculture and the needs of

the farmer have received more thoughtful and sympathetic consideration by legislative and administrative agencies during the past two and a half years than at any previous period in our history. It is not out of place here again to refer to some of this legislation.

The emergency tariff, enacted promptly in 1921, checked the dumping on our markets of surplus agricultural products which had accumulated in other countries.

The provision for emergency credit which was made available through banks and cooperative associations saved large numbers of them and their farmer patrons from bankruptcy.

The extension of Government supervision over the livestock markets and market agencies has resulted in putting a stop to innumerable unfair practices, has given assurance of open and competitive markets, and gives opportunity to make a thorough study of the packing and distribution of meats.

The law which brings the grain future trading markets under Government supervision has afforded an opportunity for an investigation and study of these markets which in time should lead to beneficial results.

Cooperative marketing associations have been given protection from unjust prosecution and encouraged to function freely, with the view to enabling their members to reduce marketing costs and market their crops in an orderly manner.

The agricultural credits act enables the Federal reserve system to handle agricultural paper for longer time, increases the amount which may be loaned on farm mortgage to the individual farmer, and provides a system of intermediate credit especially adapted to farm needs. This act when under full operation should not only vastly improve farm credit facilities but materially reduce interest rates.

These and other laws of real but lesser importance than the ones mentioned have been very helpful in improving agricultural conditions. Those who may have hoped that the depression could be turned all at once into a period of prosperity by some sort of legislative magic have perhaps been disappointed, but those who realized that our difficulties grew out of the period of disorganization resulting from the terrible World War have been able to note beneficial results from this legislation.

All the administrative agencies of the Government have been at work with vigor and good judgment to help overcome the farm troubles, through enlarging consumption at home, extending abroad the markets for the farm surplus, promoting the readjustment of production so far as practicable, gathering and making known information concerning world consumption and production, and in innumerable other ways which it is not necessary to set forth here but which will be dealt with later in this report.

### NEED OF FURTHER IMPROVEMENT.

Notwithstanding the progress made toward better times, and notwithstanding all that has been done so well by both legislative and administrative agencies, it ought to be understood clearly that there is still room for much improvement in the state of agriculture and that we can not reasonably expect to attain to that condition of national prosperity for which we hope so earnestly until the farm group, which comprises about 30 per cent of our total population gets its fair share of the national income and is able to sell the products of its labor at prices fairly relative to prices of what it buys. Industry, commerce, and industrial labor may prosper for a time at the expense of agriculture, as indeed they have during the past three years, but the longer that continues the more hurtful to the Nation will be the results. The truth of the statement that in the United States national prosperity must rest on a sound and prosperous agriculture stands unchallenged.

Producers of those crops which are practically all consumed at home are in the main finding themselves able to make such readjustments as are necessary to meet changing markets and prices and are doing so with a courage that commands admiration. In the case of some crops time will be required to make these readjustments, especially in regions remote from markets which were brought under production because of favorable freight rates covering long distances. The advance in freight rates has worked great hardship in some of these regions, and if maintained will make necessary a change of markets or of crops. By and large, however, growers of home-consumed crops will gradually adapt themselves to changed conditions, even though at considerable loss.

The case is very different, however, with producers of those crops of which we export a considerable surplus and the price of which is largely influenced by large exports from competing countries which enter the world stream as it flows to points of consumption. Under present conditions these producers find themselves producing at costs beyond their control and which make it impossible for them to compete and live decently. The condition of the wheat grower serves to illustrate the difficulty. He has been producing at practically war costs and is meeting competition which forces him to sell at prices well below the actual cost of production. The result is that those farmers who depend mainly, or evenly largely, on wheat as a source of income are going back steadily year by year. Thousands of them already have gone bankrupt, and more are well on the way.

### THE WHEAT SITUATION.

*Speaking of the wheat situation and proposals for relief of the wheat grower, Secretary Wallace says:*

There has been prepared in this department a very complete report on the wheat situation in all of its aspects. This report will be made available to those who may have occasion to use it, and it is not necessary here to add to what has already been said on page 4.

Many suggestions have been made as to ways by which the wheat grower might be helped out of his distressing situation. Among these may be mentioned:

Reduction of acreage. Since the acreage was largely increased to meet war demands, and since we now have a surplus, reduced production is looked to at once as the obvious cure.

Diversification—the growing of other crops from which part of the necessary income may be derived.

The organization of the wheat growers into a powerful cooperative.

The fixing by the Government of an arbitrary price which will cover cost of production.

Liberalizing the immigration law to bring in farm laborers and thus reduce cost of production. Also to bring in industrial workers in the hope of reducing industrial wages.

An increase in the tariff.

The purchase of the surplus by the Government and storing it against a time of short production.

The sale of fifty to one hundred million bushels to European Governments whose people can not afford to buy, but who are in urgent need of food.

The purchase of the surplus by a Government agency and selling it at a lower price in the world market.

Combination of two or more of the suggestions made.

Reduction of acreage has been taking place at a rate much greater than is generally realized. The acres of wheat harvested increased from 47,000,000 before the war to a peak of 75,000,000 in 1919. From that high point the acreage has shrunk to 58,000,000 the current year. This shrinkage has been due to the substitution of other crops for wheat where such substitution offered a possible profit, to the abandonment of wheat farms in regions where because of repeated crop failures or financial stress such abandonment was forced, and to the reduction of acreage on other farms and ranches because of shortage of labor at a price the wheat grower could afford to pay. The acreage in wheat is still larger than is necessary to meet the needs of home consumption, assuming that we have normal crop years, and reduction is going on. It must be kept in mind, however, that in large areas of the West and Northwest soil and climate are better adapted to the production of wheat than any other crop. Farmers in those sections are fixed for growing wheat, their farm equipment is adapted to it. They can not all at once change to another crop, even if some other crop gave fair assurance of profit. On the whole, the shrinkage in acreage has been as rapid as could be expected.

In many sections of the country which heretofore have specialized on wheat substantial progress has been made in diversification. A study of the tables and graphs which will be found in our special wheat report tells this story very clearly. But diversification in any large way requires that more of the land be fenced, more buildings provided, more machinery of a different kind purchased. It also requires a better knowledge of general farming methods. In short, the wheat farmer must have both time and money to shift into more general farming, even in regions where that is clearly the best thing to do. Most of them, however, probably can and should produce on their own farms more of the milk, butter, eggs, meat, and vegetables which they need for their own tables and thus cut down a

substantial part of the out-of-pocket expense. Cooperation of Federal and State agencies with local committees to help worthy farmers help themselves ought to be productive of good results.

The idea that the Government can arbitrarily fix a price that will cover cost of production and by this means restore prosperity to the wheat grower is no longer entertained by any considerable number. It is clear that such a course would simply stimulate production, not alone in the wheat country proper but in the great humid sections which can produce large crops of winter wheat and will if the price is more attractive than the prices of corn and oats. A Government fixed price would make it necessary for the Government to be prepared to buy at that price, and without some means of disposing of the surplus bought our last state would be worse than the present.

The bringing in of foreign farm laborers with the thought of reducing production costs through cheaper farm labor seems visionary. The pull of higher industrial wages would operate about as effectively on them as on our own people. If they should stay on the farms and thereby increase production, that would hurt rather than help, for we already have more farm production in important crops than can be sold at a fair price. A large increase in labor in the industrial centers might tend to reduce costs of the things the farmer buys and would add that many more mouths to be fed here.

The purchase and holding by the Government of our surplus wheat might prove of temporary help, provided an advance in price, which is the object sought, should be protected by the necessary advance in the tariff. The existence of a large surplus, however, would exert a constant downward pressure on the price of the next crop, large or small. Unless production is controlled, an annual crop, except for a reasonable carry over, must be sold annually.

The proposal to sell a considerable part of our surplus to some country which can not buy for cash but which is in urgent need of food is worthy of consideration. This would involve selling on long time and taking evidences of indebtedness, issued by State or municipal governments, calling for payment over a term of years. Commercial exporters can not extend credit for the length of time needed nor safely take the risks involved, but the Government, through some suitable agency, might well consider it. Such plan

contemplates the free distribution of the wheat, or preferably flour, by the purchasing government and the amount thus sold would be taken out of the competing market.

The existing tariff has given a substantial measure of protection to the growers of certain varieties of wheat but not sufficient to make good the difference in cost of production and marketing here and in some competing countries when all factors are considered. Any effort which has the effect of advancing wheat prices at home must be supported by an advance in the tariff on wheat. A study of the conditions which influence the cost of wheat production in the United States and Canada has already been submitted to you.

The organization of wheat growers into a successful powerful cooperative marketing association might enable them to control the flow of wheat to market more effectively and to reduce marketing costs. It ought to be possible, although admittedly difficult, to adapt to wheat marketing the methods which have proved successful in the marketing of many other farm products. But the amalgamation of the many existing associations into one powerful body and bringing into it the large number still unorganized is the work of years. Even if it were done now, the fundamental difficulties of the wheat grower right now are too deep-seated to be eliminated by such an organization.

The proposal, which has been advanced and considered from time to time for two years past, to set up a Government agency with broad powers to buy and export wheat and other agricultural commodities of which we produce a large exportable surplus, is in my judgment one of the proposals which like several others is worthy of renewed consideration at the present time. The objective to be attained is to secure for wheat and other agricultural products an exchange value approximately equal to what it was before the war. As has been said often, one of the chief causes of the agricultural depression is that farm commodities are relatively far cheaper than before the war. The price of wheat in dollars at terminal markets is not far from pre-war prices in dollars, but a bushel of wheat on the farm will buy much less of the things farmers need or desire than before the war. The end sought, therefore, is to put farm products on a price plane comparable with the price plane of other commodities.

The proposal in question contemplates the setting up of a Government export commission charged with the duty of disposing of the surplus in the form of wheat or flour in such a manner that the domestic price may rise behind an adequate tariff barrier to the point of restoring the pre-war purchasing power of wheat in the domestic market. Such an agency would need money with which to operate, and it is proposed to start it with a working capital of, say, $50,000,000, that being the approximate sum which the Government made in the way of profit by its war-time handling of wheat and flour when the price of wheat was arbitrarily controlled and held below the price at which it would have sold without such control. In case losses should be incurred because of the character of its operations, it is proposed to recover the losses through the levy of an excise tax on the crop of wheat itself. In the end the cost would be paid, not out of the Public Treasury but from assessment on the growers benefited and should not be large.

That in briefest form is the essence of the plan suggested. It is not a proposal for price fixing, as that is generally understood. It might be described as a plan to give the wheat grower the measure of protection which is given to so many other groups by making fully effective the principle of the protective tariff on a commodity of which we produce a surplus and which is suffering from destructive competition in a depressed foreign market. Or it may be described as a plan by which the Government, without material loss to itself, undertakes to do for the wheat growers what they can not now do for themselves—bring them into a general wheat pool through the operation of which they may secure a fair price.

The proponents of this plan suggest that it avoids the stimulus to overproduction which is a serious objection to arbitrary price fixing, and that the mechanism of marketing wheat now existent need not be seriously interfered with, assuming that exporters evidenced a willingness to cooperate with the export corporation. This is important, because the reason for the corporation should gradually disappear as the reestablishment of normal conditions through natural economic forces restore normal price ratios.

While the plan proposed could be applied more easily to wheat than to some other agricultural products, obviously if favorably considered it should not be confined to dealing in wheat alone. It should

include all agricultural products of which we have a considerable exportable surplus and the prices of which are substantially out of line. Especially should provision be made for handling pork products, of which we export large quantities and which also were brought under Government control during the war.

Many objections, some of real merit, can be urged against the scheme proposed. It is conceivable that there are some obstacles which may not be easy to overcome. However, there seems to be so much of merit in the proposal that it is worthy of the most painstaking analysis and the most critical scrutiny. The principles invoked are such as have been successfully applied in times past by private initiative by industries which have successfully disposed abroad of an embarrassing surplus.

If farmers could control their production as does organized industry, or if they could exact a price for their labor as does organized labor, unusual action by Government might not be demanded so urgently. It is just as well to keep in mind that both industry and labor are beneficiaries of Government action and that such action during the war and the two years following has added not a little to the farmer's difficulties.

It is well to remember also that our population is growing rapidly and that before many years there will be a home demand for even more of farm products than we are now producing. If, during this period of agricultural distress, we permit production to be shrunk to present needs by driving farmers from the land and into the cities, we shall be under the necessity of reclaiming at large expense the productive land which is now being abandoned. And if we should experience one or two years of short crops while this process is going on, the consuming population will find itself compelled to pay prices for farm products which will impose upon it a burden comparable to that under which the farmer has been groaning.

On the assumption that it is the national purpose to keep ourselves on a self-sustaining basis agriculturally, wisdom would seem to justify going to some trouble to help farmers bridge over a period of depression caused by an economic cataclysm. Precisely that thing has been done in the case of labor and of some industries. Those who urge that economic laws should now be permitted to have free play with agriculture do not give full consideration to what happened during the war and for two years afterwards.

### HELPING FARMERS TO HELP THEMSELVES.

Whatever may or may not be done by government, it is perfectly clear that the success of the individual farmer will depend on his own efforts. That he must work hard goes without saying, but under present conditions it must be work with the head as well as the hands. The crops to be grown and the kind of farming to be followed must be determined not alone with an understanding of the conditions which influence production but with some knowledge of the prospective demand for those crops and some study of the conditions which are likely to influence the price. The Department of Agriculture is trying to help the farmer help himself both in determining what to grow and how to grow it and in putting in his hands the kind of information concerning domestic and foreign conditions which he needs to produce and market to the best advantage.

The change in railway rates has led to the necessity of readjusting the agriculture in the regions surrounding many of our cities. Food products which were formerly produced under more favorable soil and climatic conditions and shipped great distances can, with present freight rates, be produced on the neighboring farms and delivered to these cities with profit. A start has been made in helping the farmers around certain centers of population to solve their problems of readjustment to these changed conditions. Joint market demand and farm management surveys have been made for Altoona, Pa.; Boston and Springfield, Mass.; New York City, and Tulsa, Okla. It is believed that owing to lack of information with regard to local demands, foods are often shipped great distances when they might be sold with greater profit close at hand. The purpose of these surveys is to help farmers make the readjustments in their farming and marketing which will enable them to provide the local markets, so far as they can profitably do so, with such food products as have formerly been shipped great distances. In the larger cities the study of market demand has a broader significance than providing information for the near-by producers. The market analysis research which has been conducted for the past two years in New York City and Boston looks toward the development of methods of measuring and forecasting the market demand in these consuming centers. Other consuming centers, particularly those located in the one-crop producing areas, should be surveyed in a

similar manner. It is hoped that State agencies will take up these studies, as it is impossible for this department to pursue them in any large portion of the country.

### WORLD DEMAND FOR FARM PRODUCTS.

To compete successfully the farmers of the United States need to know the world demand for the commodities of which they produce a surplus for the world markets and the conditions under which their competitors are producing. To meet this need a world crop and market reporting service has been developed for the purpose of collecting, summarizing, and interpreting information as to demand and competition in foreign markets.

The International Institute of Agriculture has greatly improved its reporting service to the Department of Agriculture in the past year. The institute has promptly cabled reports of conditions and estimates of important crops and livestock from all of the countries of the world reporting to the institute. For example, an estimate of the wheat crop in Argentina is cabled to the institute within a few hours after the estimate has been released in Argentina and in turn is cabled to the United States, and the same day this report is broadcasted from the Department of Agriculture by radio, telegraph, and press release. In this way the farmer may know as soon as the trader the size or condition of the crop in other parts of the world. Greater use will be made of this and other information on agriculture in foreign countries as its value to agriculture in this country is more fully recognized.

### SURVEY OF WORLD AGRICULTURE AND WORLD MARKETS.

To continue to adjust American agriculture to meet the needs of an ever-changing world market situation, it is necessary to know the trend of production in foreign competing countries. The war had a profound effect upon many of our competitors as well as upon our own markets. As in the United States, the conditions of production in these countries are continually changing. To meet the need for such information a world survey of agricultural production has been inaugurated.

A close study has been made of agricultural conditions in Europe with a view to a better understanding of the rapidity with which

the peoples of western Europe were reestablishing their pre-war normal in agricultural production, and particularly in order that the American farmers might be informed regarding the revival of those lines of agriculture in eastern Europe which compete with the American farmer on the western European markets. Detailed studies have been made of the agriculture of the Danube Basin, and a survey of western Europe is now in progress. Detailed reports have also been made on agricultural competition and demand in Argentina, Chile, and Peru.

Representatives of the department are stationed in England and Germany for the purpose of reporting on agricultural and other conditions affecting the demand for farm products. These representatives, through their contacts with importers of farm products, with Government officials who know agricultural conditions, and through direct study of the agriculture of the countries in which they are located, have kept the department informed by radio and by cable of the important developments in foreign crop and market conditions.

Representatives of the department are sent abroad from time to time to help our foreign buyers to a better understanding of the United States grades and standards which form the basis of commercial transactions in farm products exported from the United States. Thus the foreign work not only provides information which facilitates the better adjustment of American agriculture to world conditions but services are rendered also which facilitate the marketing of our agricultural surpluses.

### FORECASTS OF CROP AND LIVESTOCK PRODUCTION.

The value of accurate forecasts of crop and livestock production can not be questioned. The more that is known of what is likely to occur in the future, the more intelligently can plans be made. This is particularly true regarding agricultural production, for which the machinery, when once put in motion, must usually be kept going throughout the season, regardless of the fact that production may be greatly in excess of the demand at prices that will be profitable to the producer.

INTENTIONS-TO-PLANT SURVEYS.

Producers need information to guide them in making proper adjustments between the acreage planted to the various crops. The department began last spring to furnish this information. This was done by securing from many thousands of farmers prior to spring planting statements of the number of acres of various crops which they intended to plant. A similar report relating to fall-sown crops was issued in August. These reports will be issued semi-annually hereafter. When the purpose and value of these reports on intentions to plant are thoroughly understood they will exert an important influence and assist materially in adjusting acreage by preventing the over or under planting of particular crops. Although this is the first year that this work has been attempted, favorable results have already been noted.

A study is under way to ascertain in a scientific manner the factors which should be considered in forecasting the price of a particular product. There are signs of price changes which appear before the changes occur and serve as advance indications of the price movements. The practical purpose of the price analysis work is to give the farmer the benefit of a scientific analysis of price movements so that he may be able to make the best estimate possible from the facts available.

Farmers of necessity make production and price forecasts. On the basis of their forecasts they plan what they will undertake for the coming year, how much land they will use, the acreage they will put into each of the various crops, the livestock they will keep, and when they will market their products. While forecasts have always been made by farmers, it is believed that facts can be furnished which will make their forecasting more accurate than it ever has been.

The "intentions-to-plant" reports are not in any sense forecasts of acreage or yield, although they have sometimes been taken as such. They indicate what is in the farmer's mind at the time the report is made. When the general intention is made known individual farmers can then change their intention in the light of the new information.

Following the reports on "intentions-to-plant" mentioned above, it was felt that a comprehensive estimate of the general outlook

would be of special value to producers. A group of well-known economists and statisticians were invited to meet in Washington on April 20 last to consider the report on intended crop plantings and other materials relating to demand, and to prepare a statement on the general factors now underlying the agricultural situation with a view to furnishing all possible bases for intelligent adjustment of production to demand. This committee drafted a concise statement on the general economic outlook which it is believed has been of material aid to all agricultural interests.

This group met again on July 11 to consider the foreign and domestic demands for farm products, the wheat situation, and the corn-hog situation. A valuable report was prepared, consisting largely of the presentation and interpretation of data collected by the Bureau of Agricultural Economics, which set forth the salient facts governing the agricultural outlook at that time. This report has been received with much interest by farmers, bankers, traders, and many others interested in the agricultural situation.

### COMPARATIVE ESTIMATES A GUIDE TO MARKETING.

Producers also need information to guide them in determining when to sell their crops and livestock. This need the department is striving to meet by issuing promptly after harvest, as a supplement to the regular forecasts of production, an estimate of the quantity of each crop produced, together with comparisons with previous years. In order to give a more complete picture, information concerning foreign production is also gathered and published. Thousands of farmers study these reports from month to month and are guided in their marketing operations by them.

### PIG SURVEYS.

The special pig report which was issued in June, a year ago, showed a marked increase in the intentions of the farmers to breed for fall pigs, the increase amounting to 49 per cent in the Corn Belt States. When the report was made in December showing the actual number of fall farrowings, it indicated that this intention had been practically cut in two. Undoubtedly the information furnished by the department as to the increase had an important effect in reducing the fall pig crop to a more reasonable basis.

The report of July 1 of this year showing intentions to breed for fall pigs again showed an increase for fall farrowings, but judging from the large number of sows which have been going to market during the summer, farmers changed their plans when they learned the general intention and the actual fall farrowings will fall much below the expressed intentions of the farmers. That is the result to be desired from these reports.

Receipts at the various markets, which permit the checking up of these estimates, indicate that it will be possible to forecast quite accurately the probable movement of hogs to market several months in advance of the actual movement.

### ACREAGE ESTIMATES IMPROVED.

The problem of estimating acreage is one of the most difficult confronting the crop forecaster. In order to secure greater accuracy, therefore, a measuring instrument has been devised for attaching to an automobile by which the linear measurement of all fields in various crops bordering on highways can be easily and quickly made. By covering sufficient territory a very accurate ratio between the areas in different crops can be determined and by covering the same highways year after year, the change in acreages in various crops can be worked out. Successful experiments have been made with this instrument and it will be used in practically all States hereafter.

### LIVESTOCK REPORTING.

This year a long step in advance has been taken in the work of livestock reporting. Practically a new service has been started for the purpose of estimating actual production for market, available supplies, and movement of cattle and sheep. Estimates were issued on December 1, January 1, and March 1, last, of the number of cattle and sheep on feed in the Corn Belt as well as in the western States. Weekly reports were issued during the height of the season of the lamb movement in the Colorado-Nebraska district, showing the actual movement to market. The total number of lambs shipped out of this district checked very closely with the estimates made at the beginning of the season. Reports of the available supply of feeder cattle for spring and fall shipment were made for a number of western States, and hereafter will be made for all States which

ship feeders. Reports were also made monthly for 17 western States showing pasture and feed conditions, as well as the condition of livestock on the ranges. An immense amount of historical data for previous years was compiled from the records of railroads, stockyards, concentration points, local packing establishments, and other such agencies, in order to secure a background for the quantitative estimates of movement.

### COST OF PRODUCTION.

Cost data form the basis of the selection and combination of livestock and crops so that the largest net return may be secured by the farmer. Through cost studies farmers learn how to reduce their costs through more efficient management. Cost of production data are being gathered in representative areas throughout the United States with this object in view. The material is being used by large numbers of producers in these areas in the organization and operation of their farms.

The department is building a structure of index numbers of costs of production, national in scope, which will give the trend of production costs for all the important farm products entering into domestic and foreign commerce. The factors of production, such as labor, equipment, machinery, and fertilizer are being obtained in quantity as well as value units, which make possible a comparison of the basic requirements in agriculture with those of manufacture and public utilities. These agricultural cost trends should be very valuable to our legislators in deciding agricultural policies, to the farmers in helping them forecast probable cost trends, and to those industries directly dependent upon the farmer in planning their production programs. Knowledge of price and production trends helps farmers decide what to produce and helps to stabilize production. Standards of production are being worked out also from which farmers can judge the efficiency of their own operations.

Cost studies are furnishing information of specific value at the present time in the boll-weevil-infested areas of the South. The gradual expansion of the boll-weevil area has led to a study of the cost of the cultural methods and practices and crop rotation systems which best combat the weevil. On the basis of these studies systems of cotton farming are being worked out with a view to securing the highest net return per unit of expenditure.

The disastrous financial condition of so many of the range cattle producers at the present time has led to the general belief by many western cattle producers that possibly some changes in their methods of meat production should be made. In an endeavor to be of assistance to the beef producers, field work in ranch costs and management was begun in the spring of 1922. These ranch studies are being combined with similar studies on cattle using the national forest ranges. From this work the department will be in position to make known the methods of handling and systems of beef production which will produce the best results under present conditions.

### READJUSTING THE FARM PROGRAM.

Hand in hand with the cost of production studies are the studies of farm management and farm practice. The work in farm management in the past has been largely the studying of normal agriculture. This year we have turned our attention to applying the results of our studies of normal agriculture to unusual conditions which exist in many sections.

For example, the northern Great Plains area has suffered severely. The Department of Agriculture during the past year was called into conference with the agricultural colleges in this region with a view to devising some measure of relief for the farmers in the Northwest. This region during the last years of the war, when the price of wheat was high, suffered an unprecedented series of dry seasons which greatly reduced agricultural production, and more recently the price of wheat has been far below the cost of production. As a consequence land values have depreciated, farmers have become discouraged, and the prosperity of the region has been in grave jeopardy. Recognizing the seriousness of the situation, a spring wheat regional council was organized in the department about a year ago.

### SPRING WHEAT COUNCIL.

This council appointed two committees to cooperate with similar committees representing the agricultural colleges in the spring wheat States, one committee dealing with production and the other with the marketing of agricultural commodities in that region. At a conference held in St. Paul last January a report was prepared containing recommendations of measures which it was believed would help provide immediate relief to the farmers of the region.

A comprehensive study of farm organization and land utilization in the region has been begun by the department in order to determine in just what parts of the region a permanently profitable agriculture can be established and just what types of farming are best suited to the different parts of the region.

### AGRICULTURAL CREDIT.

The agricultural credits act of 1923 established 12 intermediate credit banks, one to serve each of the Federal land-bank districts. It increases from six months to nine months the term of discount on agricultural and livestock paper by the Federal reserve banks. It broadens the definition of agricultural paper so as to include credit used in the preparation for market and the marketing of agricultural products by farmers' cooperative associations. It increases from $10,000 to $25,000 the maximum mortgage loan to individual farmers by the Federal land banks. It gives the borrowers from the land banks a measure of control of these institutions. It authorizes the organization of national agricultural credit corporations which will prove of special benefit to the parts of the country where the livestock industry is most prominent.

While the law does not authorize direct loans to individual farmers, local agricultural credit corporations may be organized by such farmers in order to obtain discount privileges. In some States evidently the State laws must be amended before farmers can get the full benefit of the Federal law in this way. Bankers and business men in communities where present facilities are inadequate may also organize such corporations. Only in localities where present credit facilities are inadequate or where local banks, by reason of the limitation upon interest rates provided in the law, or for other reasons, refuse to avail themselves of the facilities for intermediate credit afforded them by the new banks, is it believed necessary or desirable that agricultural credit corporations should be established.

This agricultural credits act if vigorously administered should be most helpful in furnishing the sort of credit needed to meet the peculiar needs of the farmer.

### INCREASED ACTIVITY UNDER THE WAREHOUSE ACT.

Changes have been taking place in methods of marketing and financing farm products due to the increased credit facilities which

have been extended to farmers and the development of the federally licensed warehouse. For example, the cotton which was formerly sold abroad quickly and financed abroad is now held in this country, warehoused and financed in this country, and sold gradually.

The year 1923 marked the greatest progress in the licensing of public warehousemen under the United States warehouse act for the storage of agricultural products since its passage in 1916. This is shown in the following table:

*Number of licensed warehouses.*

| Kind of warehouse. | To April 1, 1921. | | To June 30, 1922. | | To June 30, 1923. | |
|---|---|---|---|---|---|---|
| | Number. | Capacity. | Number. | Capacity. | Number. | Capacity. |
| Cotton | 238 | 429,975 bales | 270 | 1,210,000 bales | 331 | 2,639,200 bales. |
| Grain | 56 | 2,108,400 bushels | 265 | 14,450,000 bushels | 231 | 20,297,047 bushels. |
| Wool | 5 | 24,375,000 pounds | 18 | 27,500,000 pounds | 15 | 32,100,000 pounds. |
| Tobacco | | | 14 | 68,400,000 pounds | 51 | 219,475,000 pounds. |

Much of the progress made is attributable to the attitude taken by growers' cooperative associations and bankers toward receipts issued under the law. A number of cotton and tobacco growers' cooperative associations refuse to place cotton or tobacco in any warehouse not licensed by the department. Resolutions favoring the licensing of warehouses under the United States warehouse act have been adopted by many banking and clearing house associations. The Federal Farm Loan Board, in administering the intermediate farm credits act of 1923, in its preliminary rules and regulations included a rule reading as follows: "Intermediate credit banks will accept the receipt of any warehouse licensed and bonded under the Federal warehouse act."

The formation of cooperative growers' associations, the improved credit facilities made available by the Government, and the attitude of large banks are all encouraging the producer to hold his crops for a longer period after harvesting and thus encouraging more orderly marketing. The Federal warehouse act has clearly demonstrated its value in this movement.

Until February 23, 1923, the act applied only to cotton, grain, wool, and tobacco. On that date the law was amended so as to apply to such agricultural products as might be considered properly stor-

able under the act. The department has since received requests from many sections for licensing warehouses for the storage of beans, eggs, and other cold-storage products, apples, potatoes, and many other products. Just as fast as the necessary trained men can be found to add to the staff, warehouses for the storage of additional products will be proclaimed licensable.

### MARKET NEWS SERVICE EXPANSION.

This year marks the first substantial expansion in the market news service of the department since the funds were curtailed at the close of the World War. For the present fiscal year Congress increased the appropriation for this work by nearly $300,000, this increase being granted for the purpose of extending the service to the far West and to the South. On July 1 the leased wire was opened to San Francisco, passing through Denver and Salt Lake City, and on September 1 a similar wire was opened to Atlanta, Ga., passing through Richmond, Va., and Raleigh, N. C. Offices at Los Angeles and Portland, Oreg., were opened on July 1, and are reached by radio and commercial wire service from San Francisco.

New branch offices were opened in both the West and South to collect and disseminate market information. While this expansion does not restore the nation-wide system that existed during the war-emergency period, the extension to the far West and to the South are making our market reports available to a very large number of producers. This extension has imposed a heavy burden upon the working force in the larger market centers, however, and further additions to these forces will be necessary in order to maintain the scope and quality of the work.

Before the extension to the Pacific coast can be of the greatest usefulness it will be necessary to increase our program by reporting a number of crops, such as prunes, which heretofore have not been covered. Urgent demand has been made upon the department also for the reopening of branch offices in a number of important eastern markets, but until additional funds are made available it will not be possible to meet this demand.

### RADIO NEWS SERVICE.

Radio broadcasting as a means of disseminating market information has been given a thorough trial during the past year and has

fully demonstrated its value. Through the cooperation of the Navy Department the high-powered radio stations at Arlington, Va., Great Lakes, Ill., and San Francisco, Calif., have been used in transmitting market information which has reached a large portion of the country.

The secondary broadcasting by radio telephone has been further developed, and now any farmer who has an adequate receiving set may get full market reports from the air in practically every part of the United States. An inquiry among county agents showed that the number of receiving sets on farms is rapidly approaching a quarter of a million and that through the distribution of these reports by local schools, farmers' organizations, business houses, etc., the market information is becoming available to a large proportion of our farmers.

### INCREASED DEMAND FOR INFORMATION ON AGRICULTURAL SITUATION.

Conditions during the past year throughout the country have tended to increase the demands made upon the Department of Agriculture for facts and figures which help to interpret the constantly changing situation. In line therewith the department has attempted to make still more effective its machinery for disseminating timely economic information. Through its extension organization it has succeeded in maintaining excellent contact for this purpose with farmers and farm leaders. Charts and statistical summaries have been sent out at regular intervals and these have been widely used by individuals and the press. A condensed summary has been prepared each month, showing the trend of important economic factors, such as production, consumption, movement, and prices. This monthly summary has been issued as a mimeographed circular under the title "The Agricultural Situation." This circular contains a terse statement of the month's developments in production, prices, movement to market, exports, cold storage, and business factors reflecting demand for farm products.

### SHIPPING POINT INSPECTION SERVICE.

For the fiscal year 1923 Congress authorized this department to inspect fruit and vegetables at shipping points. This opened the field for a new service of supreme importance to the fruit and vegetable industry, as it makes it possible for producers and ship-

pers wherever the service is available to secure an inspection by a Federal inspector before the product is shipped. This service is permissive only. The certificates issued are prima facie evidence in the courts of the United States as to the grade and quality of the product inspected. In many shipping areas the demand for this service was already loud and insistent.

To meet this active and potential demand it is estimated that no less than 1,000 inspectors will ultimately be necessary, although a majority of them will be part-time men. It should be noted that over 550 inspectors have been licensed during the first three months of the current fiscal year. It is expected that this work will pay its own way through the fees collected, but these fees must be made reexpendable or there must be provided a fund of about $1,000,000 annually upon which to draw for salaries and expenses. The act, however, carried not a dollar of increase for the inspection item, although the work to be done at shipping points is fully ten times as extensive as that previously done in the terminal markets, where an average of 50 inspectors were employed.

The department was therefore limited to such work as could be done through cooperative agreements with certain States, especially those whose officers could operate revolving funds. Under these agreements the inspectors have been employed and paid by the State, and the fees have been assessed by, paid to, and reexpended by the State. We have licensed these inspectors, supervised their work, and charged the State a fee, which has gone to the United States Treasury as miscellaneous receipts.

Although active work has been possible in less than half the States, certificates were issued on 72,666 carloads of produce at shipping points and on 28,169 cars in terminal markets. This means that every one of these shippers held prima facie evidence of having made a good delivery if he based his sale on the Federal certificate. It means also that every buyer who demanded "Government certificate attached to bill of lading" bought with assurance that a competent and impartial inspection had determined the variety and grade of the fruits or vegetables offered him.

The economic results of this innovation have been spectacular in the swiftness of their development. They promise to be well-nigh

revolutionary in their ultimate effect upon fruit and vegetable marketing.

First, the true meaning of standardization has been brought home to the grower as never before.

Second, the growers' organizations have improved the quality of their offerings and have found a new and acceptable basis for pooling.

Third, potato growers especially have learned what sort of stock should not be shipped at all except in years of extremely high prices.

Fourth, the shipper has a new basis upon which to offer his product and has no fear that the prospective buyer will discount his statements.

Fifth, the buyer can order in safety without seeing the goods.

Sixth, the certificate acts as a general insurance policy in case of loss or damage in transit.

The trade quickly realized that this service made possible a new system of car-lot marketing. Auction companies have been formed in both eastern and western cities which sell only cars in transit and on which certificates have been issued. The success of this system has been marked from the start. On the first 500 cars of cantaloupes thus sold the commissions were only one-third as high as those generally prevailing at the time. The final destination of the car was determined during its first day on the road, and it moved without indirection or delay to the place of consumption. Meantime the shipper had his money, transmitted by telegraph, within 48 hours after loading his car. Thus has the road between producer and consumer been shortened and straightened, and a clear saving of 10 per cent of the f. o. b. price has been effected by the shipper.

Prior to last year our inspection service in terminal markets had never earned in fees more than five-sevenths of the appropriation made by Congress for this work. Last year, without curtailing the city service and without a dollar of increase for this item, we more than trebled the number of cars inspected and have returned to the Treasury six-sevenths of the amount appropriated. When considered in connection with the profound reforms and economies to which the work has given rise, this is one of the most marked accomplishments of the year in our entire field of economic service.

STANDARDIZATION OF FARM PRODUCTS UNIVERSALLY ACCEPTED.

The benefits from well defined and generally accepted standards for farm products are no longer seriously questioned. With premiums being paid for products of uniform grade, coupled with high costs of transporting and handling nonstandardized products, farmers have come to realize the value of this work. Standardization of fruits and vegetables received fresh impetus from the inauguration of the shipping point inspection, as uniform standards are fundamentally necessary to the successful operation of an inspection service. At the present time Federal standards are being used for a large number of the most important fruits and vegetables, and many of these standards have been made mandatory under State laws.

After several years of intensive work, Federal grades were recommended for a number of the most important types of hay. These grades have been very well received on the part of producers and the trade, and are used as the basis for the inspection service on hay which was inaugurated on July 1 of this year.

On February 23, 1923, the warehouse act was amended so as to permit of the storage of any agricultural product, considered by this department to be properly storable, in a federally licensed warehouse. As a preliminary step to the enforcement of this act, it is necessary to establish Federal standards for all products to be stored in licensed warehouses.

Tentative standards have been established covering dark-fired, flue-cured and sun-cured types of tobacco of Virginia and the Carolinas and the dark-fired tobacco of Kentucky. Other tentative standards have been recommended and investigations are being continued.

The department's market classification for livestock has been further revised and is without doubt the most complete classification for meat animals ever attempted and constitutes a long step forward in standardization. Classes and grades of dressed meats have also been prepared which are proving of great benefit to the livestock and meat trade.

In response to strong appeals from both the domestic and foreign trade, Federal grades for rye were promulgated on July 1 of this year. These grades have received hearty indorsement from all

branches of the trade. The demand for these grades by buyers in Europe, as well as by the domestic trade, indicates a wholesome confidence in the value of inspection certificates issued by licensees of this department.

### UNIVERSAL STANDARDS FOR AMERICAN COTTON.

An outstanding accomplishment of the year has been the establishment of universal standards for American cotton. With the passage of the United States cotton standards act on March 4, 1923, requiring the use of the official cotton standards of the United States in interstate and foreign commerce, the desirability of an international agreement on standards became increasingly evident. Accordingly, a conference was called at Washington on June 11, 1923, at which representatives from the leading cotton exchanges of Europe met representatives of the American cotton trade and officials of the Department of Agriculture, and reached an agreement that the official cotton standards of the United States for grade and color with some slight modifications should be adopted as universal standards for American cotton.

It was agreed that in so far as commerce in American cotton is concerned the entire world will use identical names to represent standard qualities. Contracts covering the agreements and rules under which the foreign trade in American cotton is to be conducted have been signed by the Liverpool Cotton Association, Manchester Cotton Association, the Havre Cotton Association, Bremen Cotton Association, Barcelona Cotton Association, and Rotterdam Cotton Association. By this agreement the international cotton business will be greatly simplified and the cause for disputes and reclamations largely eliminated, as the same standard will be applied to the cotton throughout its entire course from the time it leaves the farmer until it reaches the spinner in any part of the world. The path between the farmer and the consumer will be shortened, with the result that the producer will receive a larger share of the proceeds from the sale of his cotton to the European spinner.

### GRAIN-CLEANING DEMONSTRATIONS.

One of the most serious problems in connection with the grading of wheat has been the question of dockage. Records for the past 18 years show that wheat arriving at terminal markets has been

marketed with increasing amount of trash and foreign material. For example, with respect to hard red spring wheat produced in the central spring-wheat belt, records covering a recent crop movement show that there was marketed with the wheat over 10,000,000 bushels of trash and foreign material. This is a burden upon the producer of wheat and represents an economic waste which this department has been working to overcome with a view to putting more dollars into the farmer's pocket for the wheat he produces. To accomplish this, the department has developed a cleaning device designed for attachment to threshing machines. Educational work is being carried on to bring about the general use of this device and to demonstrate the value of marketing clean grain, as it will insure enormous financial benefit to the wheat grower.

### AUTHENTIC FARM POPULATION STATISTICS.

A detailed study of the movement of farm population in eight rural counties of the United States from census reports of 1920 is practically completed. This study, to be published by the Bureau of the Census, will furnish authentic information as to shifts of population from farms to villages and cities and vice versa, as well as "moves" from farm to farm in various sections of the United States.

### FARMERS' STANDARD OF LIVING STUDIED.

The main purpose in connection with studies on the farmers' standard of living is to determine what farm families use and what they pay for the various materials such as food, clothing, rent, fuel, and other things. Another purpose is to learn what proportion of the expenditure goes for each of the various classes of goods consumed. Still other purposes are to obtain information concerning living conditions actually prevailing in certain selected areas and to determine the relation of success of farming, of value of house and its furnishings, and of several of the more social factors to the family living. Such information gathered from various parts of the United States is needed by institutions attempting to direct agricultural development on a sound basis. It will help to answer some of the questions regarding the advantages of city versus country life, so far as the material well-being of the families is concerned.

### FARMERS' MUTUAL INSURANCE.

The department has aided and encouraged further improvement in the methods of operating the farmers' mutual insurance companies in all parts of the country and has brought about the extension of this sound and economical form of insurance protection to those of the Southern States where as yet little development of this kind has taken place. In many of the States of the South fire-insurance rates as quoted by commercial companies are so high as to make the cost of protection to a considerable percentage of the farmers well-nigh prohibitive. Experience has demonstrated that through local co-operation expenses can be materially reduced and the loss ratio can be greatly lowered by the elimination of all moral hazards, as well as the elimination of some of the physical hazards involved.

### CROP INSURANCE.

Special interest has been evident recently in the problem of insurance on growing crops. Several of the larger joint-stock fire-insurance companies have in recent years been experimenting with a broader form of insurance coverage for crops than that involved in so-called hail insurance, which has been extensively written for a number of years. The department has been glad to cooperate with the Senate committee appointed to investigate the subject of crop insurance in the United States and to contribute to the statistical and other data sought by this committee. The growing of crops is surrounded by a wide variety of hazards. The uncertainty of weather conditions, plant diseases, insect and animal pests give rise to a risk against which it would be highly desirable for the farmer to be in position to protect himself. In commerce and industry insurance protection against hazards over which the individual has no control is now very generally available. It seems reasonable and proper that the producer of crops should also be in position to safeguard himself against total or serious loss of his annual investment of capital and labor after doing everything possible on his own part to bring about a harvest.

### AGRICULTURAL COOPERATION.

During the past three years farmers in the United States have turned to cooperation for the solution of their marketing difficulties in ever-increasing numbers. In a period of rapid expansion it is

only natural that the essential principles and limits of cooperation at times should be overlooked. The department believes, therefore, that its most helpful activity in this field consists in collecting and compiling the essential facts with regard to the cooperative movement and employing these data as the basis of careful studies of the older and more successful cooperative organizations. In this way an understanding of the general movement may be gained, and the principles which have guided well-established organizations made available to newcomers in the field.

The department has undertaken, consequently, to collect and compile the vital facts regarding existing cooperative organizations. Out of an estimated 10,000 associations in the United States information regarding form of organization, financial status, kind of products sold and purchased, volume of business, marketing methods, and similar features is available for approximately 6,000. Information regarding well-established cooperatives is even more complete than the figures given would indicate. Current material is made available to those interested in cooperation through the publication every two weeks of a 16-page mimeographed circular containing economic, legal, and statistical information regarding cooperation in the United States and foreign countries.

Detailed studies of a cooperative sales agency for cranberries and a cooperative citrus-fruit marketing agency were completed during the year. The purpose of the studies is to point out, first of all, the general principles which have made these organizations successful; to point out also the particular problems each organization has had to meet and the way in which these problems and other special conditions have affected its development. A study is also being made of cooperative organizations which have failed, in an effort to determine the causes for failure of cooperation.

The objective of the department's work in cooperation, in brief, has been to collect the facts regarding the cooperative movement, to ascertain by careful study the principles which will serve as guideposts for the movements, and the factors which point toward danger and possible failure.

It is important to remember that there have been previous periods of expansion and decline in cooperative activity in the United States. Cooperative sentiment is always stimulated by agricultural depres-

sion. The first great cooperative movement in agriculture reached its apex about 1874, but lasted for only a few years thereafter. Local work went forward in the later years of the nineteenth century, but it was not until after 1900 that the present period of expansion began. It increased gradually for a number of years, gaining momentum about 1914, and is now at a maximum.

There have been many failures of cooperative associations, although there is no reason to believe that the number of failures of such organizations during a given period varies materially from the number of failures in other enterprises under analogous conditions. It was only natural that the number of failures of cooperative associations should be especially large following the World War, during the period of falling agricultural prices, just as the number of business failures in cities should be and was very large. The causes of the failures appear to be similar to the causes of failure in other lines. The main cause was falling prices. Other causes were poor management, inadequate financing, and too small a volume of business in proportion to the overhead expenses. Some associations purchased, largely on credit, buildings and equipment at war prices, and the subsequent decline in the value of such property, coupled with the decline in the price of agricultural products, was largely responsible for their failure.

Business failures in cities are a natural economic phenomenon which we record statistically from day to day. It is a barometer of business activity. It is taken as a matter of course. When a cooperative enterprise composed of farmers fails it flashes across the metropolitan press in glaring headlines. Business failure is the cut and dried method by which society has decreed that the unnecessary enterprises be eliminated.

The Capper-Volstead Act, which became a law on February 18, 1922, specifically recognizes the right of farmers to associate for the purpose of marketing their products. This act clears the way for cooperative effort.

A principle which can not be too strongly emphasized is that cooperative associations will succeed or fail in proportion as they are efficient. The measure of their success will be determined by their ability to perform the marketing functions which they under-

take fairly, economically, and efficiently. Success will necessarily be governed by the skill and energy of the management. The State agricultural colleges could render helpful service by strengthening their courses in economics and marketing and by offering special courses for the training of cooperative managers.

### OUTLET FOR MEAT WIDENED.

Through efforts of this department and the Department of State during the past year a wider market for domestic meats, particularly pork, has been made available. The most recent evidence of this is the opening the Netherlands to shipments of pork. This new market, together with the English market, which was opened to the same products about 18 months ago, now gives the farmers of this country a considerable additional outlet at a time when production is at a high point.

The Government of the Netherlands requires that fresh pork shipped to that country shall be handled under certain specified conditions. These conditions have been met as a result of modifications agreed upon after suggestions were made by this department. It is expected that this new arrangement will result in a great deal of new business, just as resulted from arrangements made with England which removed any doubts regarding the wholesomeness of American fresh pork.

Up until about a year and half ago there had been no fresh-pork trade between this country and England, but during the past year this trade amounted to practically 20,000,000 pounds, the equivalent of well over 100,000 mature hogs.

It is hoped that other importing nations may come to understand the exceptional cheapness and wholesomeness of our pork and be willing to remove the restrictions which seem to work to the disadvantage of their consumers as well as our producers.

### NEW ORGANIZATION IN EFFECT.

Adjustment of the work of the department to the new plan of organization which went into effect July 1, 1923, has been going forward satisfactorily. Broadly speaking, the new organization provides for the coordinating of the three main divisions of department work, each under a directing head. The offices of director of scientific work and director of regulatory work were provided

for prior to the past year. The newly created office was director of extension work.

The director of scientific work is expected to coordinate and supervise all activities looking to the finding of new scientific facts. The director of extension work has charge of all branches active in the sending out of these new facts and other information to the public. This work is done largely through extension agents in cooperation with agricultural colleges. The director of regulatory work has charge of the administration of the numerous laws coming under the department. His work is very closely associated with scientific work, as research along scientific lines is necessary in the administration of many laws.

Another important feature of the plan of reorganization is the establishment of the Bureau of Home Economics. This bureau is in charge of a woman, scientifically trained and experienced, and has a program outlined which will greatly strengthen our scientific knowledge of foods and problems affecting the women of this country.

The editorial and distribution work, formerly the division of publications, has been placed in charge of an assistant directly responsible to the Secretary. This position was provided for by the last Congress and makes it possible to materially strengthen this phase of our work.

### HOME ECONOMICS WORK STRENGTHENED.

With the establishment of the new Bureau of Home Economics coordination and cooperation of the work already being carried on has been made possible. Plans have been made to begin research in new fields which must be explored scientifically if the department is to render the greatest service to the home maker. Problems will be undertaken according to their relative importance to home makers as far as the department is able to determine them.

At a conference of home-economics specialists called by the department last summer it was expressed and agreed upon that the new bureau should undertake research work in the following subjects: Food and nutrition, clothing and textiles, economics (including household management), equipment, eugenics, and art in the home. Among these recommended subjects we hope to stress particularly economic studies, experiments in the field of textiles, and

clothing and equipment studies. Under the economic phase of this work standard-of-living studies appear to be greatly needed to furnish information of fundamental importance. The factors entering into clothing costs are not sufficiently established, and detailed study along this line is highly important. There is a wide field of work in the continuation and extension of the economic use of food. Studies of the cost of housing are at present acutely needed. Very little information is now available to the housewife to help her in choosing textile materials and clothing, and it appears very urgent that something should be done to furnish the housewife with reliable guidance in her purchases of household equipment.

These are only representative of the many problems confronting this new bureau, and indicate the great field of research work which this department should explore if it is to be of the utmost help to farm and city women.

### SCIENTIFIC RESEARCH.

In the field of scientific research many things have been done during the year which are valuable contributions to both scientific and practical agriculture, and to various industries. Many of the new discoveries are plainly contributions which should make living easier and more comfortable. It is not possible to enumerate all of these additions to knowledge which cover a great variety of subjects, including plants and animal breeding, cultural methods, means of fighting insect, animal fungous, and bacterial enemies of crops and animals, and new methods for handling crops after they have left the farm. The reports of the various bureaus contain much detailed information and are available in limited numbers.

Results of research work on animal parasites afford striking evidence of the practical value of scientific experimentation. One of the most conspicuous examples is the discovery that carbon tetrachloride is an effective remedy for the removal of hookworms of dogs, a discovery which has led to the wholesale application of this treatment against hookworms of human beings with great success in many parts of the world. Investigations regarding roundworms of sheep and swine have made it possible to overcome, to a large extent, the enormous losses caused by these parasites.

A unique, practical method for the prevention of damage to the harvested fruit of Florida oranges and grapefruit by stem-end rot

during transportation, storage, and distribution has been developed to the stage of commercial application. The economic importance of this reduction of distribution hazard and prevention of waste of wholesome fruit is readily apparent when it is remembered that these two crops in Florida alone now yield from 13,000,000 to 16,000,000 boxes each year.

Recent studies of the salts carried in irrigation water have given a somewhat different point of view for the consideration of alkali troubles in irrigated land. In many districts the chief concern of the irrigation farmer is to prevent accumulation of alkali salts in harmful quantities in good land, rather than to reclaim salty land for use in crop production. These observations indicate the importance to the irrigation farmer of understanding the character of the soil solution and of using irrigation water in such a way as to prevent the accumulation of excessive quantities of soluble material from the soil.

Two different methods have been developed for determining the total quantity of colloidal material in soils and it has been found that colloids constitute a far larger part of the whole soil than previously had been thought, some of the heavier soils containing from 60 to 70 per cent. Progress also has been made in determining the properties of the colloids present in different soils. With these facts established it should be possible to gain a more correct insight into the chemical processes of the soil than has hitherto been possible. It is now possible to get a better insight into the nature of soil composition, and the new methods are applicable in the study of agricultural soils, of material used for building levees and foundations, of drainage and irrigation conditions, and of geologic formations.

By modifying the process ordinarily used in the preparation of ammonium phosphate so as to include the use of commercial potassium chloride, as well as phosphoric acid and ammonia, it has been found that a product containing all of the essential constituents of fertilizer, and of corresponding concentration, may easily be obtained. Chemical and physical properties of this material make the new method admirably suited for preparing fertilizer material for transportation. Manufacturing concerns have taken such an interest in this process as to express a willingness to test it out on a commercial scale.

A laboratory to develop work on the chemistry of crops was established during the year. There is need for work concerning the influence of environment on the chemical composition of crops, including certain features of fertilization, such as the relation of composition of crop to the time of fertilizer application. Past work on the composition of agricultural crops has been directed chiefly toward what may be termed the quantity viewpoint. The new work is directed more toward the subject of quality. The chemist is now seeking to learn whether or not there is danger of producing quantity at the expense of nutritive quality. For instance, it is known that the application of a certain fertilizer, say, sodium nitrate, at a definite time, as one month after sowing, to a crop like corn will increase the yield quantitatively. However, practically nothing is known about quality relations; that is, whether the proteins, vitamins, or mineral components of the corn so fertilized are superior or inferior for animal and human nutrition. The economic value of improvements in quality resulting from this research may exert a marked influence upon future agricultural practices.

The physical investigations conducted at the Arlington Experiment Farm, Arlington, Va., and elsewhere with and without the cooperation of other agencies are fast providing a scientific basis for highway design, reducing uncertainty to a minimum and assuring a greater degree of economy in highway construction expenditures. As a result of observations made at the Bates road in Illinois, a design for one of the types of highway surface has been formulated which will reduce the cost by $1,500 a mile without decrease of strength. The department cooperated with the Illinois Department of Public Works and Buildings in this investigation.

### INSECT ENEMIES.

The fight against insect enemies, which grows year by year, involves the use of various methods for eradication and control, and for preventing the introduction of new kinds from other countries. During the past year progress has been made in introducing insect enemies of the corn borer from Europe. During 1922 more than a million specimens of one species were liberated in the New England area. Arrangements have been perfected with the Canadian department of agriculture to supply colonies of this parasite for possible establishment in southern Ontario, where the

corn borer occupies a large part of the peninsula bordered by Lakes Ontario, Erie, and Huron. Another parasitic species which first was liberated in Massachusetts in the fall of 1922 has been recovered from the field in several different localities in New England, and the establishment of this species there seems now assured. There were no developments of great importance in the corn borer situation during the past year.

Study of calcium arsenate dusting methods for checking cotton boll weevil infestation showed that some success has been achieved by this means. Severe weevil infestation in 1922 caused a more extensive use of calcium arsenate than ever before, and a shortage of this material developed. A special investigation was made of the results secured by approximately 1,100 farmers who dusted altogether 125,485 acres of cotton. These farms were quite uniformly distributed over practically all of the Cotton States. Slightly more than 96 per cent of the farmers using calcium arsenate were successful in controlling the weevil to the extent of making the operation profitable. The average increase in yield upon these farms was 339 pounds of seed cotton per acre. Special studies were conducted to determine the minimum yield per acre on land where dusting with calcium arsenate would be justified by the results obtained. It was found that in general the season's dusting on any particular farm should cost not to exceed the current value of 100 pounds of seed cotton per acre in order to make a profit by the dusting method.

### BLACK STEM RUST OF WHEAT.

The barberry eradication campaign, the objective of which is the control of the black stem rust of wheat and other cereals through the eradication of the common barberry, which is the intermediate host of this destructive fungus disease, has been systematically prosecuted during the year in 13 States of the Mississippi Valley and the Great Plains region, where it was begun in the spring of 1918. The initial survey has been completed in Wyoming, and but few counties remain to be covered in Colorado and Montana. During the entire campaign more than five and three-quarters million bushes have been located on more than 55,000 properties. These are destroyed by thorough uprooting or by the application of common salt or diluted sodium arsenite where the conditions render these materials practicable and safe.

### WHITE-PINE BLISTER RUST.

Field surveys during the past season by Federal, State, and Dominion scouts have disclosed that the destructive rust of five-leaved pines, which in western North America was first observed on pines and currant bushes in southwestern British Columbia in the autumn of 1921, is widespread throughout the coast belt of British Columbia. As several large areas in that Province have been found where the disease is epidemic on pines, and the advance infections have been found on pines within 100 miles of the international boundary and on cultivated black currants within 35 miles of that boundary, the situation must be regarded as serious. The climatic and topographic conditions of the western region and the host plants involved are markedly different from those in the east, so that eastern methods will presumably require considerable modification to adapt them to the western conditions.

### WAR ON TUBERCULOSIS.

Rapid advances were made in the cooperative campaign to eradicate bovine tuberculosis. An increase of 76 per cent was made in the number of herds of cattle officially accredited as free from tuberculosis. At the close of the fiscal year there were 28,536 such herds, comprising 615,156 cattle, and there were under supervision more than 400,000 herds containing nearly four and a half million cattle. Unfilled applications for testing nearly a million additional cattle were on file.

The plan of eradicating tuberculosis from circumscribed areas, with the county as the unit, has met with marked success. Fifty additional counties were freed during the year, raising the total to 81. Arrangements have been made to accord special facilities for shipping cattle from counties known as "modified accredited areas" without the usual quarantine restrictions. In the course of the year's work the tuberculin test was applied to nearly three and a half million cattle. Those found diseased were slaughtered under inspection, as a rule, and indemnity was paid to the owners. Larger financial support is being provided by States and counties, and the work is growing in favor with cattle owners.

### IMPROVEMENTS IN BREEDING AND FEEDING.

The systematic effort to improve domestic animals in the country, which began nearly four years ago under the slogan "Better Sires—Better Stock," continues to grow and is now a project of considerable size and importance. At the close of the fiscal year, 11,533 livestock owners had filed with the department written pledges to the effect that they have placed their farms on a strictly purebred-sire basis and agreed to use good purebred sires exclusively in their breeding operations for all classes of animals kept.

Results of a questionnaire study on current livestock problems and how farmers are meeting them show briefly that in the experience of nearly 500 livestock owners the general economy of rations, the cost of grains, and more specifically the cost of protein, represent more than half of all feeding difficulties. The question of balancing rations is next most important. Livestock of improved breeding were reported in the great majority of cases as making greater gains or producing more than scrubs or common stock when fed in the same way. The average superiority of improved stock in the use of feeds, as shown by financial returns, was 39.6 per cent over common stock.

### WILD ANIMAL PESTS.

From the beginning the department has maintained that eventually it would be practicable to destroy completely some of the worst animal pests, and thus forever eliminate the heavy losses they have been causing. Through the campaigns against them, prairie dogs have been exterminated on considerable areas, and the large wolves, of which 4,900 have been killed, are being so reduced in numbers that over most, if not all, of the West their end is in sight.

The best evidence of the growing appreciation of the practical value of campaigns against animal pests in the West was given by the legislatures of 13 States in the winter of 1923, which made total appropriations of about $647,000 for cooperation in the work during the following biennium.

Improved poison combinations and their systematic distribution have been so successful that poisoning is rapidly superseding other methods of predatory-animal control. The great increase in territory that can be covered by poisoning campaigns, as now conducted,

for the first time offers a possibility of eliminating coyotes over vast areas. This has hitherto appeared doubtful, owing to the numbers and wide distribution of these pests. More than 200,000 square miles were covered by organized poisoning operations during the year, and at carefully established poison stations on this area more than 1,703,000 specially prepared poison baits were distributed.

Clearing the ranges of coyotes is proving a boon to the cattlemen as well as to the sheepmen, for with the practical elimination of the gray or timber wolf over much of the range country of the Western States, cattlemen have discovered that heavy losses of calves, heretofore attributed to wolves, have evidently been due to coyotes.

A national drive undertaken against house rats, both through publicity and demonstrations, has developed widespread community sentiment against these destructive rodents, as evidenced by the steady growth of organized campaigns to destroy them and to eliminate their sources of food and harborage.

### IMPORTANCE OF WEATHER WORK.

The department is making its weather work pay back to the Nation many hundreds of dollars for each dollar expended. The forecasts issued twice daily for all sections of the country and warnings of frosts, cold waves, storms, heavy snows, whenever conditions warrant, all of which are widely and effectively distributed through newspapers, by telephone, telegraph, radio, maps, bulletins, cards, and other means, meet general requirements, but the rapidly increasing utilization of weather information by many business industries is resulting in requests for more special forecasts and direct service.

In addition to the hundreds of thousands of receiving-set owners who receive the forecasts by radiophone, large numbers of whom can obtain them in no other way, many repeat them to their neighbors by telephone. This latter form of service has become so potential that arrangements are in hand for a definite form of organization which will replace the telegraphing of forecast messages now sent to centers for distribution. It is expected that more effective service will be accomplished thereby and that considerable economy will result.

It is estimated that the value of perishable products saved as a result of cold-wave warnings issued last winter for the Chicago

district alone exceeded $10,000,000, although the winter was not an unusually severe one. Reports from Alaska, made available through the cooperation of the Signal Corps of the Army and office of communications of the Navy, were an important factor in making the warnings timely and accurate. Alaskan observations were an equal factor in the cold-wave warnings issued in other commercial districts. An organized unit of the Weather Bureau has been in operation in Alaska since 1916, and its activities have been of great value to the commercial and marine interests of the United States.

Flood warnings proved of great value during the year. During the Arkansas Valley flood livestock and other property to the value of $1,350,000 was reported as having been saved by flood warnings sent out well in advance. The total reported flood losses during the year were $36,591,362, while the value of portable property saved by flood warnings was given, in admittedly incomplete returns, as $4,240,465.

During the year schemes for forecasting river stages and floods have been completed for the Willamette River system of Oregon, the Connecticut River, and the Brazos River of Texas. Other schemes will be undertaken as time will permit, mainly for the smaller rivers, as those for the larger rivers and their tributaries are virtually complete.

With the advent of the practical navigation of the air a whole new service is now demanded, a service of flying weather forecasts and weather advices to aviators. This compels the bureau to get above the surface and extend its observations, measurements, and advices into the free air, which is being done in a very limited way at the present time by means of kites and little so-called pilot balloons.

### HEADWAY WITH HIGHWAYS.

Eight thousand eight hundred and twenty miles of Federal-aid roads of all types were completed during the fiscal year, which, added to the mileage completed prior to the fiscal year, brought the total of completed projects up to 26,536 miles. The projects under construction at the close of the year amounted to 14,772 miles and were estimated as 53 per cent complete.

The total amount of Federal aid actually appropriated for use up to and including the fiscal year 1923 was $375,000,000. Of this amount, $364,250,000 was apportioned among the States.

The total mileage of highways in existence at the time of the passage of the Federal highway act, as certified by the State highway departments, was 2,859,575 miles. Under the law the maximum mileage that can be included in the entire system is 200,170 miles. The mileage included in the 35 systems approved up to the close of the year was 111,699 miles, and the total length of the whole system, when it is finally designated and approved, will probably not exceed 179,000 miles.

Analysis of the approved systems for the 35 States shows that of the 1,111 cities of 5,000 population or more in these States 1,049 of them lie directly on the approved system. When the Federal-aid system is correlated with roads constructed by the States and counties, as it doubtless will be, the remaining cities of this class will certainly be connected with the main interstate system, and one will be able to travel from any point in the country to almost any hamlet, however remote, without leaving an improved road for more than a few miles at most.

The indications are that these roads, when they are completed, will pass within 10 miles of the homes of 90 per cent of the people of the United States, considering the country as a whole. In some States the percentage of the population thus served will be still greater, reaching close to 100 per cent in a number of instances.

### TOBACCO GROWERS BENEFITED.

Field tests conducted on "tobacco-sick" soils in the Connecticut Valley have brought out marked differences in the effects of various crops on the growth of tobacco following in the rotation.

In extensive field tests in the southern manufacturing and export tobacco districts it has been demonstrated that mixed fertilizers containing 2 to 3 per cent potash and applied at the usual rate of 800 to 1,000 pounds per acre frequently do not supply sufficient potash for the tobacco crop. As a result, characteristic symptoms of potash hunger are frequently observed in the field. On light soils, and especially in comparatively wet years, equally unfavorable results may be expected when a sufficient quantity of magnesia is not con-

tained in the fertilizer or otherwise added to the soil. The quantity of magnesia required by the crop, however, is comparatively small—perhaps not more than half that of the potash which is needed. With constantly decreasing supplies of cottonseed meal and other similar materials containing appreciable quantities of magnesium, it is apparent that there will be greater necessity for making special provision for magnesium in the fertilizer mixture.

### POSSIBILITIES OF RUBBER PRODUCTION.

On the basis of a special appropriation for this purpose, more extensive investigations of rubber-producing plants are being undertaken to determine the possibilities of producing rubber in the United States or in adjacent tropical regions. The need of developing other sources of supply is shown by the rapidly increasing consumption in the United States and the serious danger of supplies from the East Indies being interrupted. About nine-tenths of the world's supply of crude rubber now comes from the East Indian plantations, while three-quarters of the total supply is used in the United States. These two facts are a standing challenge to both agricultural scientists and business men.

In view of the large number of plants that are known to produce rubber and of the wide range of diversity among such plants in habits and conditions of growth, adequate determinations of cultural requirements and possibilities are not to be expected until many observations and experiments have been made. Facilities for experimental work are being extended in the different regions where rubber-producing plants can be grown, and expeditions are being sent to foreign countries to study the habits of the plants under native conditions and to secure the best stocks for propagation and breeding purposes, so that vigorous, high-yielding strains may be developed as the basis of production.

Under the existing world conditions it is clearly desirable that a thorough study of the potential rubber-producing plants of the world be carried forward vigorously and without interruption, with a view to ascertaining the most promising sources of increased supplies of rubber to meet the increasing requirements of our industries and of the users of rubber, who now constitute practically the entire population of the country.

### BINDER-TWINE FIBERS.

Some years ago cooperative work was organized by the office of fiber investigations and the Philippine Bureau of Agriculture, the purpose of which was to encourage the increased production of sisal and maguey fiber in the Philippine Islands. In view of the rapidly increasing consumption of abaca (Manila hemp) for binder-twine purposes, this cooperative work has been expanded to include necessary work with abaca. It is entirely possible, if not probable, that the ultimate solution of our binder-twine fiber problem will be an increasing substitution of abaca for henequen in the manufacture of binder twine.

In cooperation with the Philippine Bureau of Agriculture and with the bureau of science and the college of agriculture, preliminary steps have been taken during the present year to organize this work. An increased use of abaca for binder-twine purposes will benefit both the United States and the Philippine Islands, and should be encouraged in every way possible.

Continued improvement has been made in the quality of the Philippine machine-cleaned maguey fiber. American manufacturers report that this fiber is now entirely satisfactory for binder-twine purposes.

### IMPORTANT MANUFACTURING AND HANDLING.

Work on production of cane sirup of uniform quality was carried forward, as a result of which farmers producing cane sirup were enabled to consolidate their output on a sufficiently large scale and into such a uniform product as directly to interest brokers and wholesale grocers in the distribution of their product in a systematic manner. A central blending and canning plant, with a daily maximum capacity of 5,000 gallons, equivalent to 500,000 gallons for a 100 days' operating season, was designed for the Texas Farm Bureau Ribbon Cane Growers' Association. This plant was erected at Lufkin, Tex., and operated during the season of 1922–23. Cane sirup from various sections of eastern Texas was shipped by members of the association to the Lufkin plant, where it was graded, mixed to insure uniformity of grade, treated by the invertase process perfected by the department to prevent crystallization, canned, labeled, crated, and marketed. Technically the operation was an unqualified success. A study was made of the manner of producing

cane sirup on the farms, and directions showing how the quality of the product could be improved were distributed to farmers.

Work on methods for profitably utilizing cull and surplus oranges and lemons has been done. Investigations in previous years helped to establish industries manufacturing useful products from oranges and lemons that otherwise would go to waste. In the last (fiscal) year effort has been directed toward perfecting methods for the commercial production of pectin from waste orange and lemon peel. Pectins produced by various methods have been standardized as to their jellying power, and work has been done on the production of jellies of different consistency. Attention has been given to the preparation of marmalades and jellies from dehydrated oranges. As a result of the studies on the production of pectin, new methods for the preparation of marmalade and orange butter have been evolved.

A method for determining the degree of maturity of cantaloupes, depending upon the sugar and solids content of the fruit, was developed by the Bureau of Chemistry and used with gratifying results by growers and shippers of cantaloupes. A criterion of maturity for selecting the time to pick melons has long been sought by melon growers.

### THE EXTENSION SERVICE.

There was noteworthy progress during the year toward the adjustment of the cooperative extension work of the department to new conditions, with a view to its functioning under the supervision of a director of extension work, as provided for by act of Congress. The effort has been to unify the work for the men, women, and boys and girls on the farms and to enlist all extension agents in the promotion of the enterprise as a whole. Probably the most marked development in the extension work during the past year was the increased emphasis given to the development of unified farm and home extension programs based upon the actual needs and interests of each community.

Approximately 4,670 persons are now employed in the cooperative extension service in agriculture and home economics carried on by the department in cooperation with the State agricultural colleges. About 2,100 counties have agricultural agents, 840 have home-demonstration agents, and 160 have agents working exclusively with farm

boys and girls. In addition, 800 specialists in different phases of agriculture and home economics are employed to aid the county extension workers and to give advice and assistance in special and emergency situations. It is estimated that farms and farm homes adopted not less than 4,000,000 improved practices through the efforts of the extension workers during 1922, of which at least 924,000 were brought about through home-demonstration work. The total enrollment in boys' and girls' club work during 1922 was approximately 600,000, and 358,000 reports meeting all requirements were received. The total value of all products reported produced by club members was approximately $8,650,000. There was an increase during the year in the number of negro extension agents employed. There are now 294 negro field agents, and substantial progress in the work of these agents is reported.

The exhibits prepared to illustrate the department's work and the best agricultural practices have proved their value by the great increase in the demand for them from fairs, expositions, conventions, farmers' weeks at State colleges, and from various other sources. A conservative estimate places the number of persons who viewed these exhibits in 1922–23 at 8,836,000 and the number of exhibitions at 114. Specially designed exhibits have been used for calling attention to methods for controlling the white-pine blister rust, the eradication of tuberculosis in livestock, the prevention and control of forest fires, the desirability of good roads, the saving of land from erosion, maintaining the health of farm animals, and for various other purposes. The exhibits are all prepared after discussions by men in the various bureaus, and consequently they represent the best information to be had on each subject.

The increase in the demand for exhibits over the preceding year shows the department has found in them a very desirable method for reaching the people who can make use of its information. There was a 26 per cent increase in the number of persons viewing them and an increase of 63 per cent in number of exhibitions.

The past 12 months have been a notable period in the history of the motion-picture work of the Department of Agriculture. The motion-picture office and laboratory now occupies a modern, fireproof building. An outstanding development is the striking increase in the known audience reached by the films. Every user is asked to

report the number of people to whom he shows them. The audience, as actually reported for 1922, was 1,937,570; as actually reported for 1923, 4,460,077. Allowance should be made for possible exaggeration, but this consideration is balanced by the fact that many users failed to report their showings. In addition, there are no figures available in regard to the exact size of the audiences reached by the department films that have been bought by cooperating or outside institutions. As such purchased films outnumber the films owned and circulated by the department, and as many of the purchasers are known to be actively and continually circulating the films to large audiences, figures on this circulation probably would compare favorably with the figures reported to the department.

The growth of distribution would seem to be a fair indication of the value of motion pictures in the department's work, but the figures are not more impressive than the written expressions that come frequently from users of the films. These statements in general are to the effect that the films have a remarkable effect in attracting large crowds to meetings, stimulating interest in the subjects under discussion, giving clear conceptions of unfamiliar ideas, and furnishing inspirational impetus to campaigns for community betterment.

### PACKERS AND STOCKYARDS ACT.

In accordance with the general policy of the department to administer all regulatory statutes assigned to it in a constructive and helpful manner and under the broad general authority provided in the packers and stockyards act, a study of economic conditions and problems applicable to the livestock and meat-packing industry has been made both in this country and abroad. These studies have related chiefly to methods of distribution and competitive practices and conditions, and an effort has been made to give the public assurance of the wholesomeness and desirability of meat in the diet.

Some important cases involving the activities of leading packers of the country were handled during the fiscal year. One of these was pending at the first of the year in connection with which complaints had been made alleging unfair, unjustly discriminatory, and deceptive practices. The case was considered through formal hearings and special investigations, and an appropriate order was issued to

cease and desist from following certain practices and methods which appeared to be in violation of Title II of the act. Another case involves the validity of the acquisition of the assets, business, and good will of Morris & Co. by Armour & Co. It is the contention of the department that this action will lessen competition in the purchase of livestock and the sale of the products thereof, but the respondents contend that such acquisition was an industrial and economic necessity. This case is pending.

Arbitration of livestock commission rates at six of the principal markets was under way at the end of the fiscal year as a result of a complaint by the leading livestock producers' organizations. Representatives of the complainants and respondents agreed to submit the whole question to arbitration, and two members of the staff of the packers and stockyards administration were agreed upon as arbitrators. An exhaustive investigation was made by the department to furnish the arbitrators with the necessary information for an impartial decision, and a preliminary report was made. the final report coming after the end of the fiscal year.

Cooperative shipping of livestock is generally regarded as an established feature of livestock marketing, and while the cooperative selling of livestock is comparatively a recent development, it has become a substantial factor in the marketing process. With the establishment of these cooperative agencies at some of the principal markets there appeared to be a feeling on the part of some of the old-line agencies that they were justified in fighting this form of competition through the practice of boycotting. Whereupon the administration found it necessary to take action and bring about an understanding that open-market principles must prevail in every respect at public markets.

Other activities have been correction of reweighing charges at a number of stockyards; the valuation of stockyards property as a basis for study of rates and charges; the securing of better prices for bruised, crippled, diseased, and dead animals, and for cattle reacting to the tuberculin test; improvements in the handling of stock in loading and unloading; and audits of the records of commission men at 23 principal markets and of the records of stockyard companies at 18 large markets.

### GRAIN FUTURES ACT.

The grain futures act, after a contest by the Chicago Board of Trade, on April 16, 1923, was held constitutional by the Supreme Court of the United States. The necessary action has been taken by this department and the grain future exchanges, including the Chicago Board of Trade, to continue their operations under this law without interruption. The law requires the prevention of the dissemination of false and misleading information regarding crop or market conditions and prohibits attempts to manipulate or corner the market. It forbids discrimination against cooperative associations of producers in the matter of membership. It gives the Government an opportunity to ascertain the facts of the business through reports and actual inspection of the records and transactions.

Yet when this department, following the Supreme Court's decision, issued regulations to carry into effect these provisions by requiring daily reports and access to the records, propaganda immediately developed from within the exchanges that the grain futures administration was responsible for the decline in the price of wheat. It was contended that the new regulations had decreased the volume of trading and, therefore, the price of wheat, on the ground that in effect the regulations placed a limit on trading and that speculative buyers were frightened away because their names and volume of business transactions might become known, notwithstanding that this would be at least equally discouraging to speculative sellers. As a matter of fact, no limit upon trading was specified and neither the law nor the regulations interfere with the volume of either hedging or speculation, so long as there is no attempt to manipulate or corner the market. No satisfactory explanation was given by those responsible for the propaganda as to why the price of corn rose under the same law and administration. They did not attribute a later rise in the price of wheat to the law or its administration, notwithstanding the fact that there had been no change in either.

Steps have been taken to coordinate governmental sources of information so as to combat the dissemination of false and misleading information about crop and market conditions. Supervisors are stationed at Chicago and Minneapolis and contacts arranged with the other markets to enable the department to keep in touch with current business operations. The administration is informing

itself, as rapidly as a suitable organization can be developed for the purpose, in regard to the facts of the business, so that when a reasonable time has elapsed it may be able to assure Congress and the public that it has actual facts upon the general phases of future trading that are of public concern.

### INSECTICIDE AND FUNGICIDE ACT.

The enforcement of the insecticide and fungicide act has had a marked effect upon the industry engaged in the manufacture and sale of insecticides and fungicides, and each year sees progress in the direction of more truthful labels and a higher standard of quality in the products on the market.

During the year the board has devoted a large part of its time to campaigns designed to improve the quality and labeling of Bordeaux mixture and Bordeaux-lead arsenate mixture, campaigns against disinfectants which were adulterated or the labels of which bore false or misleading claims, calcium arsenates which were deficient in active ingredients or which contained ingredients injurious to vegetation, so-called pine-oil disinfectants and coal-tar dips which were adulterated with mineral oil, insect powders adulterated with powdered daisies, and alleged boll-weevil remedies.

The industry has made tremendous strides since the inception of the regulatory work, and the board is constantly confronted with new problems. Each year sees a new crop of insecticides and fungicides. Some represent new manufactures of the recognized standard remedies, but there is always a certain percentage of new theories of treatment represented by these new articles. As a result of the widespread ravages of the cotton boll weevil, various new so-called remedies have appeared on the market. The board has attempted to collect all of these with the idea of submitting them to analysis and test. This is a tremendous undertaking, and it will probably take several years' work before this situation is cleaned up and worthless preparations driven off the market.

### THE NATIONAL FORESTS.

Receipts from the national forests exceeded those during the preceding year by $267,290.71, although the normal revenue from grazing was materially cut down by the depressed conditions in the

livestock industry. There was a surplus of $200,000 in income over the regular expenditures for protection and administration, excluding construction and maintenance of improvements, other development work such as timber surveys and tree planting, and emergency expenditures in fire fighting. If the deferred payments of grazing fees allowed during the last three years are credited to the years in which they fell due instead of the years in which final settlement of these open accounts was made, there is shown an actual increase in revenue-producing business last year over the fiscal year 1922 of more than $1,000,000, and over 1920, the year in which receipts were previously at their highest, of more than $540,000.

Not only were receipts from the sale of timber 33 per cent greater than in the best former year, with a total of $2,721,876.20, but such progress was made in laying out new operating units and preparing for the increased demand for national forest timber, due to the westward movement of the lumber industry and growth in western consumption, as practically to assure a steady increase in future business. At the same time, each new unit where operations are begun is being kept on a perpetual-yield basis.

Fires on the national forests, during a year of more than average hazard, were held down for the third year in succession to a point where only a little more than two-tenths of 1 per cent of the total area was burned over and the loss caused was less than one-tenth of 1 per cent of the total value of the destructible resources protected.

The grazing regulations were worked over to make the system of regulated range use one which will contribute most to the stability of the livestock industry dependent on the forests while maintaining the full authority of the Government to control this use as the public interests may require.

The establishment of two new forest experiment stations gives larger opportunity for the research fundamental to the development of the best forestry practice, both public and private.

Economic investigations brought into clearer relief the character and extent of the public burden imposed by devastated and idle forest lands, the relation between timber requirements and our possible timber production, and the future relative need for the agricultural use of land as against forest use.

In the field of industrial investigations an accomplishment of far-reaching importance was scored in the completion of standardized lumber grades for yard lumber and structural timber of all commercial species, both softwood and hardwood. Several important lumber-trade organizations have accepted the proposed standards as practical and desirable to replace the considerable number of widely varying rules or specifications hitherto employed. This work was done in cooperation with the Central Committee on Lumber Standards, representing lumber manufacturers, distributers, consumers, and professional groups, such as architects and engineers, with the Department of Commerce and the Department of Agriculture acting in an advisory capacity.

### GRAZING ON THE NATIONAL FORESTS.

The use of the forage resources in the national forests during the past year has reflected the depressed conditions in the livestock industry of the Western States, which have been particularly acute among cattle growers. Enforced liquidation among livestock producers has, at various points, reduced the numbers of stock using national forest ranges and the income from this source; and a small percentage of grazing permittees, particularly in the Southwest, have been unable to pay the fees required by the Forest Service.

The department has handled this situation in a sympathetic way, with a view to aiding the industry to tide over its present difficulties and recover its normal status. Extensions of time for the payment of grazing fees have been allowed in many cases in connection with unbroken use of the ranges. At the same time it has been necessary to protect the Government in the ultimate payment of the amounts due and to maintain grazing permits on a business basis.

During the year special attention has been given to the revision of the policies and regulations governing grazing on the national forests. This work has been undertaken with a view primarily (1) to aid in the stabilization of the livestock industry in so far as it is dependent upon national forest ranges, and (2) to adapt the use of this pasturage to the economic needs and tendencies of the livestock industry in the Western States, particularly in relation to the most effective use of land. These two objects are, of course, closely related.

When the Department of Agriculture assumed charge of the national forests in 1905 the tide of agricultural settlement was still active in the regions adjoining many of them. In fact, one of the major problems then confronting the department was the classification of the national forests themselves and the segregation of areas which should be made available for agricultural use. The initial grazing regulations were drafted with special attention to the encouragement of the new settler in the many localities where the use of public range was essential to the successful development of farming lands. In many instances this policy necessitated a gradual but material curtailment in the herds of former users of the national ranges and a process of redistributing the grazing privileges among an increasing number of stockmen, including the small herds of new settlers.

The Department of Agriculture should always make the encouragement of rational land settlement a primary object in the administration of both the grazing and timber resources of the national forests. And it should always seek to obtain the closest possible correlation between the use of forage in the forests and the development of adjacent range and agricultural lands. The conditions affecting agricultural development in the regions where it can be aided by the forage on the national forests, however, have changed materially during the last 18 years. The main tide of new agricultural settlement has largely spent itself. At some points, indeed, homestead settlement is receding, owing to the failure of attempts at dry farming. While additional areas will, of course, be placed under cultivation as time goes on, in connection with irrigation developments or otherwise, it is evident that land settlement is not as large a factor as in 1905. It is also evident that by granting longer permits for range privileges the department will not only promote the welfare of the livestock business, and particularly its financial rehabilitation following the present crisis, but also will promote sound economic development and permanency of settlement in these regions as a whole.

The revision of the grazing regulations has consequently been directed primarily (1) toward stabilizing the use of the ranges under permits extending for a period of 10 years, and (2) toward stabilizing the livestock enterprises which the national forests support in

part by conditioning the retention of grazing privileges upon the ownership of ranch property or improvements sufficient to afford a well-balanced and efficient stock-raising business. In authorizing grazing privileges under these terms, provision will be made for such redistribution of range use as may be necessary in the future to care for needs of new settlers.

Furthermore, while encouraging more stable use of the national forest ranges in connection with the stock ranches dependent upon them, the Government does not and can not, in any sense, recognize a vested right, or servitude, attaching to the use of the range. The national forests are public properties, created primarily for the production of timber and the protection of water sources. They must be administered so as to render the maximum degree of public service through wise utilization of their varied resources. If the grazing of livestock in any particular locality should clearly become harmful to the regrowth of timber or the security of valuable water resources, the department must be able to reduce or adjust the grazing use or, if need be, to eliminate it altogether. If the economic development of particular regions requires reduction in the herds of old users to make room for the livestock of settlers who need range in developing their homes, the department must have full authority to make such redistribution of the grazing privileges as the circumstances require. The value of the range must be protected, even if that should at times require reduced grazing or a complete temporary withdrawal from use. Adjustments for these purposes should be made only after full consideration of their effect upon interested parties; but the department must retain a free hand to deal with problems or conflicts of this nature as the most vital interests to be served may dictate, and it can not be hampered in such adjustments by the creation of any servitudes on the land which have the nature of vested rights. Within this essential limitation, it is the purpose of the Department of Agriculture to stabilize the use of the national forest ranges in connection with established and dependent stock ranches to the fullest practicable degree.

### GRAZING FEES.

The question of the fees paid for grazing privileges has an important bearing upon the policy of stabilizing range use. Most of the range areas now embraced in national forests were grazed for many

years as open commons. When the first grazing fees were established in 1906 they were designedly low, representing approximately the cost of administration rather than the intrinsic value of the forage consumed. A revision of the grazing fees initiated in 1916 and ultimately completed in 1919 increased the charges materially to a point more nearly approaching the commercial value of the forage after making liberal deductions for the past uncertainty of tenure and the cost of compliance with the regulation of the Forest Service.

An extended investigation of the value of western range lands upon which to base a readjustment of the fees charged for national forest grazing permits was initiated in 1921. One of its purposes was to get away from the flat, or blanket, fees charged and to value the individual grazing allotments or districts in accordance with their accessibility, the quality of their forage, their water resources, and other factors obviously affecting their worth to the stockgrower. This is an adjustment necessary as a matter of equity between the different grazing permittees. Another purpose of the reappraisal is to ascertain the actual value of the forage in the national forests as determined largely by comparison with the rates paid for comparable range lands in private ownership in the same localities. With the data collected as a basis, the department is now in consultation with the various groups of stockmen who use the national forests, trying to work out a new schedule of grazing fees which shall represent a fair and reasonable appraisal of the individual allotments, having always in mind the economic status of the livestock industry and the effect of the policies and restrictions enforced by the Government. Owing to the present upset conditions in the livestock industry, no change in grazing fees will be made for the present.

In stabilizing the use of the national forest ranges under the beneficial 10-year permits, it is essential that the relations of the holders of these privileges with the Government be established upon a sound and unquestionable business footing. The forage in the national forests is a commercial resource, exactly as their timber is a commercial resource. The utilization of this resource by a well-established industry no more justifies obtaining it at something less than its actual worth than the lumber industry would be justified in obtain-

ing the timber on the national forests at less than its actual market value.

In other words, the very stability which the livestock industry desires and should have in the use of the national-forest ranges demands that users pay the public fairly for value received. A permanent and settled program of range use which will command public confidence and go forward without interruption can not be predicated on any other basis. The Department of Agriculture is not seeking to charge for the use of national-forest ranges more than a just price. It stands for the allocation of the forage to the stock-growing enterprises most dependent upon it and most logically situated for its efficient use. It stands for a stabilization of this use to the fullest possible degree, so that the livestock industry may prosper and establish favorable credit and banking relations. And, as an integral part of this program, it must require payment for the value of the public resources so utilized, as determined reasonably and equitably on accepted business principles.

### A CONSTRUCTIVE FOREST POLICY NEEDED.

The difficulties against which the farmers of the country are struggling to-day are dovetailed with the need for a constructive program to increase the production of timber. Many agricultural products do not bring a fair return upon the capital and labor employed in their production, and cultivation is contracting on many areas of the less fertile or more poorly situated land. At the same time, the country is rapidly draining down its diminished supply of timber and adding to the area of idle, cut-over lands which have no possible agricultural utility. The disposal of logged-off land is becoming a more and more serious problem to its owners, while to the public the economic retrogression resulting from idle land and the burdens resulting from the shortage of timber supplies grows more formidable.

The relative requirements of the country for farm and forest products call for maintaining a forest area approximately equal to the present total, including second-growth, burned, and cut-over land and abandoned farms in timber-growing belts. The cost of forest products, already oppressive, is mounting. Our present supplies of merchantable timber are fast diminishing. Our stock of

young timber is wholly inadequate to supply our needs when the grown timber is gone. The forest products obtainable from our entire area of 470,000,000 acres of actual or potential forest land, were it all producing timber at maximum capacity, would only bring production into an approximate balance with present use. At best there will be a long and acute delay before new timber crops equal to our requirements can be matured. And while there is much room for economy in the use of wood and considerable room for use of substitutes, these two palliatives taken together will probably no more than offset the increased consumption which growth in population will demand. We should therefore press forward with all possible speed to bring about the full use of all suitable timber-growing land.

This is a matter of particular importance to agriculture. Farmers are our leading class of wood consumers. Because of the present high cost of lumber the construction, repair, and replacement of farm buildings is seriously in arrears, handicapping production and lowering standards of living. In addition to their consumption of lumber, farmers require very large quantities of wood for fencing, fuel, and the like. Furthermore, the migration of forest industries from many former locations, leading to decreased assessable property values, decadence of rural economic and social life, and reduced opportunities for profitable employment, are consequences of forest destruction that weigh heavily on many farmers.

It is not merely farmers, however, who are adversely affected by accumulating idle lands and rising prices of forest products. Outside of portions of the South and West, the whole country is suffering from the effects of timber depletion. Unfortunately, the average citizen does not see clearly these effects, because he pays for most of his share of the country's consumption of wood indirectly; it is hidden in the price of nearly everything that he eats, wears, and buys. Except when he undertakes to build a home, he does not realize how much he is paying because of national improvidence in the use of our forests. No simple remedy that will cure the idleness of land and shortage of timber can be prescribed. The problem must be attacked concertedly from all sides.

### EXTENSION OF PUBLIC OWNERSHIP OF FORESTS ESSENTIAL.

One line of attack will certainly have to be an increase of publicly owned forests. That it is entirely practicable for the public to acquire woodland on terms that make its management profitable has been fully proved by the Federal Government, which has purchased more than 2,000,000 acres. The average price of these lands has been $5.29 per acre. Their market value is to-day materially greater than their cost; they are the source of a considerable revenue from the sale of timber products, and they are growing new forests at a satisfactory rate. Similar business considerations testify to the soundness of the policy of forest purchases undertaken by a number of States.

The amount of denuded forest land in the Eastern States is enormous. While much of it can and should be brought back to productiveness on the initiative of its present owners, there are millions of acres which, either because of the relatively slow rate at which trees will grow, the cost of reclamation, or inaccessibility to markets, will not for a long time, if ever, be reforested through private enterprises.

The public can promote timber production where private owners can not. One reason for this is that a reasonable return on public capital invested in such an enterprise falls below what prviate capital would expect. Another reason is that the returns in economic prosperity and varied forms of public service can be made so great that the success of the enterprise does not stand or fall solely on its Treasury receipts. Any comprehensive plan for dealing with our timber situation must include large acquisitions by the public of forest lands which in no other way can be made productive within a reasonable time.

The National Forest Reservation Commission should be empowered through appropriate legislation to extend Federal acquisition of forest land. If it seems necessary to rest this policy wholly upon the constitutional ground of protecting the flow of navigable streams, the Congress should prescribe a broad limitation to that effect, but should not handicap the judicious selection of areas by a specific form of determination in each instance. Since local as well as national welfare is at stake, every reasonable encouragement should be given to the States to cooperate with the Federal Government in buying idle forest land which can be restored to productive

use only through public ownership. The vast denuded areas in the northern Lake States and in parts of the southern pineries offer particularly urgent fields for the application of this policy.

### FEDERALLY OWNED LANDS SHOULD BE INCLUDED IN FORESTS.

The extension of public forests is not wholly a matter of acquiring lands now privately owned. There are some five and one-half million acres of unreserved public lands in the continental United States chiefly valuable for timber production or watershed protection. There are 600,000 acres of similar land within military reservations adapted to administration for forest production without conflict with its present use by the Army. There are extensive forest holdings in State ownership still in process of destructive lumbering or distribution into private lands. The reversion of delinquent tax lands, stripped of their timber, is on the increase. A national policy of forestry calls for measures that will place all of these public lands under permanent Federal or State management designed to conserve their capacity for timber production.

Occasional additions to the national forests embracing public timberlands hitherto unreserved are made by specific acts of Congress. This piecemeal attack upon a problem of such general national importance is tardy and inadequate. Other special measures have been before Congress from time to time with reference to the forested lands in military reservations, but thus far have failed of enactment.

Responsibility rests upon the National Government to do its full part in meeting our shortage of timber growth, particularly by placing lands which the Government already owns under the right form of administration. This should be done in a complete and comprehensive way. The President should be authorized by law to place within the national forests any unreserved public lands chiefly valuable for the production of timber or the protection of watersheds; and he should be further authorized by law to place within national forests any portions of military reservations chiefly valuable for the production of timber, subject to the unhampered use of such areas for military purposes as may be needed.

In order to provide reasonably for the extension of the national forests by purchase on areas where the public interests will be best served by this form of ownership, including denuded lands whose

restoration to timber growth will otherwise be exceedingly remote if not impossible, not less than $2,000,000 should be provided annually for forest purchases, and the Congress should authorize the National Forest Reservation Commission to make such purchases at any points within the watersheds of navigable streams where in its judgment the public interest in the protection of stream flow or the production of timber will be promoted thereby.

### THE PART OF PRIVATE OWNERSHIP.

By itself, however, public ownership of timberlands can not suffice to meet the national needs for wood. Nor is it necessary. Private and public forestry go hand in hand in every European country where stable timber production has come about. Both are necessary in the United States, and both are feasible. The pressure of high timber values has already brought about a substantial degree of private reforestation in parts of the Northeast. The commercial use of land for growing wood is slowly but surely spreading through the Atlantic States, in the more favorable portions of the South, and even on the Pacific coast. The outstanding fact in our national progress in forestry during the past 10 years is the extent to which timber growing as a private commercial enterprise has come about and the much greater extent to which it will be carried if reasonable forms of public assistance are rendered.

### STOPPING FOREST FIRES THE FIRST THING.

The most urgent step for the encouragement of private forestry is organized protection against forest fires. Men do not care to buy timber which may be burned the next year. The risk to young growth from forest fires is formidable unless joint action by property owners can be brought about, and, further, unless the community itself takes an aggressive part in reducing it. Educational measures to lessen carelessness with fire and police measures to reduce the negligent or intentional setting of fires are perhaps the most important need of all. In spite of the progress that has been made, we still are a Nation of woods burners.

The path to fire prevention on all forest lands has been blazed. Under the wise legislation already on the statute books the Federal Government is cooperating with 26 States, and is about to cooperate

with one more, to maintain organized systems of protection. There was spent last year on this work nearly $400,000 from the National Treasury and about $2,000,000 of State and contributed private funds. Twelve States having considerable forest areas, however, do not maintain protective organizations, and of those which do a number can give protection to only a part of their forest area for lack of adequate funds. It is estimated that the annual cost of adequately protecting all our forest lands, exclusive of the national forests, would approximate $9,250,000.

### PROMOTION OF FOREST PLANTING NECESSARY.

With fires kept out, many of our cut-over forests will restock themselves with valuable trees. But where devastation has been severe (usually through repeated fires), tree planting is essential. Various States now maintain tree nurseries and sell trees at or sometimes below the cost of growing and shipping them. Forest planting on a commercial scale is not possible without cheap plants and the present demand for small trees is far in excess of the capacity of the State nurseries to supply them. This form of public assistance to the private timber grower should be largely extended.

### THE TAXATION PROBLEM.

Present methods of taxation discourage the growing of timber. The problem of adjusting taxation to the use of land for producing a crop which matures only after many years, growing more and more valuable from an assessment standpoint yet yielding the owner no current income from which to pay carrying charges, is a very knotty one; for the cost of local government must somehow be met each year.

The capital invested in timber production should bear a tax burden neither less nor greater than that imposed on capital invested in other productive enterprises; but the owner of forest lands can not fairly be called upon to pay a yearly tax on his investment plus a steadily enhancing yearly levy—forty or fifty times—on a single crop. A solution would seem to be either in taxing the land only at its full value for timber production, or in taxing the timber crop at the time of harvesting it, or possibly in some combination of these two principles.

### THE NEED FOR BETTER KNOWLEDGE OF FOREST GROWING AND FOREST USE.

There are other investigations that must be vigorously prosecuted if we are to make our forests supply the national needs. Like agriculture, forestry must be based on a store of accumulated knowledge if full use of the soil is to be secured. Much remains to be learned about growing timber crops. There is also large room for bettering our practices in the use of forest products. In my previous reports I have mentioned the need for more research, through which alone can be obtained the technical information essential for bringing wood use and wood growth into any sort of reasonable balance. This need grows steadily.

### PRACTICAL FORESTRY BY SMALL OWNERS.

Almost one-third of our forest lands are owned by farmers. If the practice of forestry were as well developed among them as are the cultural practices applied in growing field crops, both their own returns and the quantity and quality of timber grown would be larger. In parts of the Northeast rural prosperity is closely related to the profitable use of the poorer land, which it does not pay to cultivate and which, even when kept in woods, is seldom as productive as it should be. In consequence, the machinery created under the Smith-Lever Act should be utilized to bring about better handling of farm woodlands through the method of demonstration and practical example. There is much that can be done along extension lines to increase timber production at the very point where it would most effectively aid the general agricultural situation by affording a profitable employment of inferior soils.

### AN IMMEDIATE LEGISLATIVE PROGRAM.

It is not possible at the present time to foresee just how far the efforts of the Federal Government to promote the growing of timber should be carried. Far-reaching changes in our national conceptions of land use can not be brought about overnight. Necessarily they come about by a process of evolution. The first great step toward a permanent timber supply was the creation of national forests from the public domain. A second step was taken by the Weeks law in the extension of the national forests in the Eastern States through

purchase. A third significant step was initiated by the same measure in providing for limited cooperation between the Federal Government and the States in the protection of privately owned forest lands on the headwaters of navigable streams.

The time is opportune for another forward step in national forestry policy, whose specific aim should be to give the freest possible play to the economic forces already tending to make timber a staple crop on private land, so that the movement toward reforestation as a commercial enterprise may attain all the momentum of which it is capable.

National assistance in private timber growing can be extended most effectively in four ways, which might well form the major planks in a new Federal law. These are:

(1) Provision for nation-wide cooperation with the States and private landowners in the protection of forest lands from fire, under an equitable distribution of the financial burdens entailed. Such cooperation should not be limited to the watersheds of navigable streams, but based squarely on the national benefits of reforestation, including the conservation of water sources. The maximum Federal expenditure authorized for this purpose should be not less than $2,500,000 per annum.

(2) Provision for Federal cooperation with the States in investigating the effects of prevailing methods of taxing forest lands, and in devising forms of taxation which will promote reforestation without inequity to other taxpayers. Tax legislation necessarily rests with the States concerned; but nation-wide study and leadership in this matter will be of the utmost benefit.

(3) Provision for Federal cooperation with the States in growing and distributing forest-planting material at cost or such other reasonable rates as will promote forest planting by private landowners on a large scale. The need for this form of public assistance is now imperative. It is possible thereby to multiply by several fold the present rate at which denuded lands are being replanted.

(4) Provision for Federal cooperation with the States in extension work to teach and demonstrate timber-growing methods, with special reference to timber growing on farms and other small holdings. Here also a tremendous opportunity exists for rapidly increasing the current rate of wood production in the United States.

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With these developments in the national forestry policy, and to a large degree underlying and supporting all of them, must go more comprehensive research in timber growing and in economy in the use of timber. The research facilities with these objects in view already existing in the Department of Agriculture have made notable progress, but should be expanded to meet the growing need for sound technical data on which the whole forestry movement depends.

### THE NEED FOR EXTENDING REGULATION OF RANGE USE.

Adjoining many national forest ranges are large areas of the public domain suited only for grazing purposes. Just as the accumulation of cut-over lands has been a force making for overdevelopment of farming on soil of inferior productiveness, so has the public policy with respect to these open-range lands of the West worked in the same direction. Settlement of these lands has been encouraged without consideration of the economic and social waste that results when the settler locates on land from which a decent living can not be made through cultivation because of adverse natural conditions. But a point has now been reached beyond which no substantial further development of agriculture is possible. There are still 175,000,000 acres of unreserved public lands which remain unentered. They are used in the main as grazing commons. The greater part of this land is arid or semiarid in character and supports no tree growth. It is land on which, by and large, 60 years experience has demonstrated that there is no possibility of agriculture except as limited areas may now and then be embraced within irrigation developments. For the most part, it is land whose natural productivity is low and has been steadily declining by reason of excessive and unregulated grazing. On much of it at the present time the natural forage grown on 20 or 30 acres will no more than furnish yearlong pasturage for a single cow. Much of it is land which the stockman could not afford to own and carry.

This vast area is now no man's land in very truth. The Government owns it but exercises no control over it. The sheep or cattle owned by near-by ranchmen or by itinerant herders graze it as they can. The first comer gets the best of the forage; later comers take the leavings, if there are any. Under this unregulated and destruc-

tive use most of the land has lost a large part of its original forage-producing value.

### PUBLIC RANGES SHOULD BE USED AND IMPROVED.

These open public ranges have played a conspicuous part in the picturesque history of the livestock industry of the West. Their deterioration represents, in the aggregate, an enormous loss in the natural resources on which only the industry can be maintained. Furthermore, the free and open status of these lands injects a large element of instability and uncertainty into the livestock business. The production of livestock under western conditions normally requires ranch lands where hay is grown for winter feeding and available areas of low open range for spring, or spring and fall, grazing, as well as other available areas of higher range for summer grazing. In many cases at the present time but two elements in this year-round program are assured, the privately owned ranch with its winter forage and the summer range in the national forest administered by the Department of Agriculture. During the intervening seasons, which may comprise one-third or more of the year, the stockman must hazard the safety of his herds and the success of his business upon the availability of open ranges on the public domain over which he has no control and for which he must compete in a general scuffle, with no administration by the Government.

In some cases national forest ranges have been of necessity overgrazed, and particularly grazed too early in the year, on account of the pressure from local ranchmen whose old spring range on open public lands is largely gone. In other words, unregulated spring range has become the neck of the bottle. Winter feed and summer pasturage are available for more stock than can be subsisted during the interval unless the spring range on the open domain can be protected from overgrazing and utilized in a coordinated way with the other and stable factors in the round of the year.

To restore and perpetuate one of the great natural resources of the West and at the same time to reduce the losses and uncertainties in western livestock production, the remaining open public ranges should be placed under a form of supervision analogous to that of the Department of Agriculture over the range lands within the national forests. The main objects of this administration should be

(1) to adjust the number of livestock and the seasons of use so that the forage produced on these areas may increase in volume and quality rather than deteriorate and (2) to provide for an orderly allotment of grazing privileges to the livestock producers most entitled to them by reason of the location of their ranches and their necessary yearly rotation on spring, summer, and fall ranges. Experience offers no prospect that the orderly and intelligent use of these range lands and the conservation of their forage-producing capacity can be accomplished under any scheme of distribution into private ownership. The task is one that must be assumed by the National Government.

Placing the open public ranges under regulation will in no sense be inimical to the interests of the recent homesteader or the future settler wherever settlement is possible. On the contrary, the settlers will gain more from range regulation than any other class. A fixed point in grazing administration on the national forests is to recognize the settler whose ranch development requires outside pasturage as having a prior claim upon the use of the grazing lands adjacent to his homestead. The milk and work animals of all settlers in or near the national forests are allowed free and undisturbed grazing therein. As the settler accumulates other livestock he is given the range allotments most naturally and economically utilized in connection with his home, and is protected in the use of such allotments as against stockmen living farther away and from the nomadic herds of distant owners which move about the country picking up forage wherever it may be found.

Settlers in or near the national forests who have sought to establish themselves in the livestock business have been in a far more advantageous position to benefit from public range than newcomers in other regions where the unreserved public grazing lands were at all crowded. In fact, many settlers have been unable to establish themselves on public lands because they could not obtain the range needed to supplement their homesteads and have been driven out of the country because the public range lands surrounding them were completely eaten out by the large herds of the established livestock producers in that vicinity.

The same principles should govern grazing administration on the unreserved domain. Any land that has or may develop agricultural

value should be available for settlement exactly as similar land has been made available for settlement within the national forests. And settlers whose home building depends upon livestock should be given priority in the allotment of range accessible for their use. While the bulk of the remaining public lands are not capable of settlement and must, as far as can now be foreseen, remain primarily range lands for all time to come, a system of public range regulation would promote and foster settlement wherever it may become feasible to a far greater extent than under the present unregulated and destructive use of these areas.

No group of men understands this situation or realizes the necessity for action more clearly than the western stock growers themselves. They know that their business can not be satisfactorily organized or accorded an adequate basis for credit until stable tenure in the use of the open public ranges can be secured and the deterioration of these pastures brought to an end. There is a general demand from the livestock interests of the West that some form of grazing administration be extended over the unreserved public lands. In many cases local livestock interests have petitioned Congress to add considerable areas to the national forests, not because they had any value for timber production but because these people wanted the benefits and protection of the national-forest system of grazing administration. One or two additions of this character have been made by acts of Congress in response to local public sentiment. Many areas of open public range lands which form logical portions of grazing units now partly within the national forests could, in fact, be most economically and effectively administered by adding them to the forests. The Department of Agriculture regards this as a sound and commonsense extension of the national forest system in meeting obvious present-day needs of the West; but to the extent that such a policy is adopted it should be with a clear understanding that the bulk of the lands involved are treeless and have no prospective value for growing trees. If they are added to the national forests it will not be ordinarily for the production of timber or the protection of water sources, but primarily for the protection and regulated use of range.

There are many other areas of open public land which do not adjoin national forests, and which, if placed under public administra-

tion, should constitute separate and distinct units, which might be called national ranges. The experience and judgment of the local livestock growers themselves will ordinarily afford the best index to the necessity either for the addition of grazing lands to the national forests or for the creation of separate national ranges. The problem involves enormous areas and a considerable variety in the local conditions and circumstances to be considered. It would not be wise to attempt its solution by blanket legislation applying simultaneously to all lands of the character described. It would be the wiser course to define a national policy, leaving its application to develop area by area and region by region and recognizing the principle of local option on the part of the livestock growers directly affected.

### RANGE MANAGEMENT AN AGRICULTURAL PROBLEM.

The administration of the western ranges for the production of livestock is essentially an agricultural activity. Its effective development requires much in the way of research to determine how depleted ranges can be restored, how the more nutritious forage plants can be brought back, to what extent artificial seeding can be profitably employed, what is the carrying capacity of many different types of pasturage and browse, and how intensive use of this forage can be so adjusted, by seasons and otherwise, as to maintain and build up the productivity of the resource. The results of such research must be applied in the actual administration of grazing as rapidly as may be possible without serious injury to the economic interests dependent upon the range. These are all problems of scientific agriculture; and they are problems upon which the various bureaus of this department have done a vast amount of work in connection with the administration of the national forests and other activities in the Western States.

During the past 18 years, furthermore, the Department of Agriculture has developed public-range administration on 100,000,000 acres of forage-bearing land in the national forests. It has perfected an organization for this purpose, in both its technical and administrative phases, which now has many years of practical experience behind it and is recognized for leadership in open-range grazing. The work to be done on the unreserved public grazing lands

in both its scientific and administrative aspects is simply an extension of the grazing work on the national forests. The grazing on all lands in public ownership must be coordinated, since in a large proportion of cases the same livestock uses both national forest and outside lands in the course of the season's pasturage. It would obviously be in the interest of efficiency and public economy to have one organization handle both parts of the common task. The problem as a whole is part of the general agricultural development of the country.

The specific legislation which is recommended is a law which would—

(1) Authorize the President, by Executive order, upon petition from a majority of the stockmen using the area concerned and after full investigation, to add to the national forests contiguous unreserved public lands chiefly valuable for the grazing of livestock for the purpose of conserving and regulating the use of their forage.

(2) Authorize the President, by Executive order, upon a petition from a majority of the stockmen using the area concerned and after full investigation, to create and designate national ranges comprising unreserved public lands valuable chiefly for the grazing of livestock, such national ranges to be administered by the Secretary of Agriculture in so far as their use and occupancy for the grazing of livestock or purposes directly connected with the grazing of livestock may be concerned.

For many years, while the Government has gone forward constructively in the conservation and sane use of the greater part of the timber on its public lands, and of the forage resources embraced in the national forests as an incident to the protection of timber and stream flow, we have disregarded the perpetuation and conservative use of the vast forage resource on the public domain. No small part of the insecurity and hazardous nature of the livestock industry in the West at the present time is due to inaction on this vital question. There should be no further delay in meeting this situation. The destruction of the grazing value of the public domain can not be defended.

### THE FOREST PROBLEM ONLY ONE PART OF A GENERAL NATIONAL PROBLEM OF LAND UTILIZATION.

In reality, the problems of forestry and the better regulation of the grazing resources on the public domain are merely phases—though very important phases—of the broad problem of land utilization. As the timber is cut millions of acres are thrown out of use. Some of this land is now suitable for use as farming land, some of it will be needed for that purpose in the course of time, but most of it is permanently unsuited to use for farming purposes. Of the arid or semiarid open public grazing lands, relatively little is physically capable of growing crops except where irrigation may be possible, no matter how pressing the national need for crop land may become; and under present conditions it is steadily declining in capacity for use for the only form of use to which it can be put, while being held open for entry under the homestead laws. It is clear that a proper distribution of our reserve areas between the three uses—forests, grazing, and crops—implies some kind of policy of giving direction to the utilization of our land resources.

### LAND UTILIZATION POLICY.

While many of the agricultural difficulties of the past three years have been due in part to surplus production resulting from overstimulation during the war, it is evident that before very many years our population will have grown to a point which will enable it to consume not only all we produce at the present time but considerably more. Where this increased production is to come from and how our national land resources may be best used is therefore a matter of major importance. Some two years since I appointed a departmental committee, consisting of representatives of various bureaus, to consider present and future needs for crop land, forests, and pastures; the extent and location of areas that can be made available for these various uses; and the governmental policies that should be adopted to adjust use to needs.

The more immediate problems of the adjustment of type of use to climate, soil, and economic conditions in the semiarid regions of the West have received the major part of the attention of the section working on land utilization problems. Particular attention has been given to the Great Plains as a whole and the spring wheat

section as a part of the larger field. Frequently recurring seed loans are not a solution of the problem; this lies rather in a change in the type of agriculture and farm organization.

War prices, propaganda urging increased food production, and local desire for the development of unused resources have brought about the reclamation by irrigation and drainage of large areas of land on some of which it is being found difficult to repay the cost of reclamation. Effort has been made during the past year to coordinate the policy of the Reclamation Service with the studies of this department in directing land utilization and settlement. The Secretary of the Interior has recognized the desirability of obtaining the judgment of the Department of Agriculture concerning the agronomic and economic feasibility of proposed reclamation projects and has referred such projects to this department for consideration.

Tenancy on farm lands has been increasing. Studies of the extent of tenancy and of the various forms of contract under which tenants operate have been made with a view to promoting farm ownership and the use of equitable forms of rental agreements.

Farm credits are based primarily on land values. The proper appraisal of farm lands is of great importance in order that the farmer may obtain the credit to which he is entitled and at the same time that credit agencies may have adequate security. During the year much attention has been given to a determination of the influence of the various factors affecting land values as a basis for developing scientific methods of appraisal.

It is hoped that the report of this departmental land committee will be ready for inclusion in the Yearbook of the department for 1923, and it is expected that this Yearbook will be available for distribution early in the spring of 1924.

### HOUSING SITUATION.

In previous reports I have called attention to the unsatisfactory housing of the department and have recommended a building program to meet this situation. It has not yet been possible, however, to secure an appropriation to begin work on this program. Concentration into fewer and larger buildings of a more suitable character than the existing widely scattered structures, providing proper housing for present activities, is the most important need of the depart-

ment at the present time, and I again urgently recommend that provision be made to this end.

Last year I asked the Bureau of Efficiency to study the housing problem in the department, in the hope that something could be done in the reassignment of available space. This bureau made an exhaustive investigation of the situation in cooperation with department representatives, with the result that it was found inadvisable to reassign office space, as the removal and installation of a large amount of laboratory and other heavy equipment would be involved. The recommendation of the committee regarding one building where available space was found has, however, been favorably acted upon.

The department continues to occupy more than 40 buildings in various parts of Washington. Efficient and economical administration of its affairs remains impossible while this condition exists. During the past fiscal year the Government spent $177,726.92 for rental of buildings occupied by this department in the District of Columbia.

A number of laboratories have had to be housed in rented or other temporary quarters of nonfireproof construction not intended or designed for laboratory installations or for permanent occupancy. The installation of essential apparatus and equipment for efficient work usually requires permanent foundations, costly plumbing and electric wiring, or special provision for the maintenance of constant temperatures. The present temporary character of the department's housing arrangements in some cases precludes the possibility of providing much-needed apparatus. With the development of the department's work its housing situation is becoming more and more acute, and it will be impossible to hold outstanding research workers or do efficient work in many lines until such intolerable conditions have been recognized and steps taken to remedy them. Another illustration of the need for additional space is found in the effort now being made to centralize control of purchases. Progress in this work is blocked by the lack of a warehouse to serve as a central depot of supplies.

### GENERAL ADMINISTRATION.

Continued attention has been given by the department to the adoption of ways and means of insuring the most effective and economical methods in the expenditure of public funds. Efforts are being made continually to improve the business administration

of the department and to inaugurate economies wherever consistent with effective results. In my last report specific instances of savings were cited. The same effort has been in evidence during the past year and many additional steps have been taken to better the service and reduce cost. One of the branches of the office of the Secretary has been organized in such a way as to advise and assist the administrative and accounting offices of the various bureaus in the survey of existing methods and in effecting changes in business organization where needed. Further special attention has been given to the development and supervision of the purchase and sales work under an expert in this line who has been employed for this specific purpose. Reserves have again been set up wherever practicable against the various appropriations, and these and other unused balances of appropriations were turned back into the Treasury at the end of the fiscal year.

### SALARY CLASSIFICATION.

The number of employees in the department June 30, 1923, was 20,261. More than 16,000 of these were engaged in work outside of Washington.

Careful attention has been given to the activities necessitated by the provisions of the classification act of 1923. A personnel classification officer was designated to coordinate and supervise the large volume of work incident to the classification of the department personnel.

A consideration of what has been accomplished thus far indicates that the prospects which classification offers for the adjustment of present inequalities in pay and the enlargment of opportunity for advancement are acting as a strong incentive for the continuance of effort and the rendering of efficient service. The critical analysis and evaluation of the duties and responsibilities of department employees which is now being made to insure their just and equitable allocation under the classification plan should lead to more effective administrative organization and stimulate department workers to maintain a high standard of efficiency.

Respectfully,

HENRY C. WALLACE,
*Secretary of Agriculture.*

## FINANCIAL STATEMENT.

The net cost to the Federal Government of the regular activities of the department during the fiscal year 1923 was approximately $34,500,000, as indicated by the following table:

### FEDERAL FUNDS FOR REGULAR WORK OF THE DEPARTMENT.

| | Appropriations available, fiscal year 1923. | Expenditures, fiscal year 1923. | Outstanding obligations. | Unobligated balances. |
|---|---|---|---|---|
| Agricultural appropriation act, 1923 (exclusive of appropriations made direct to States for research work under the Hatch and Adams Acts and for extension work under the Smith-Lever Act, and appropriation for the acquisition of lands by the National Forest Reservation Commission) | $33,584,173.00 | $28,540,386.90 | $4,226,005.92 | $817,780.18 |
| Deficiency appropriation acts (July 1, 1922, Jan. 22, 1923, and Mar. 4, 1923) | 774,980.00 | 651,322.01 | 48,915.84 | 74,742.15 |
| Supplemental appropriation for increase of compensation (act of June 29, 1922) | 3,232,863.00 | 2,935,862.96 | 218,943.62 | 78,956.42 |
| Permanent annual appropriation for meat inspection (act of June 30, 1906) | 3,000,000.00 | 3,000,000.00 | ..... | ..... |
| Revolving fund for classification of cotton | 134,538.29 | 80,287.63 | ..... | 54,250.66 |
| Allotment for fixed nitrogen research ($500,000 transferred from appropriation placed at disposal of the President by the national defense act of June 3, 1916, and $275,903.46 unexpended balance of allotment previously transferred) | 775,903.46 | 212,976.17 | 24,961.13 | 537,966.16 |
| Eradication of foot-and-mouth and other contagious diseases of animals (reappropriation of unexpended balance from 1922) | 353,924.93 | 53,392.49 | ..... | 300,532.44 |
| Control of white-pine blister rust (available balance of continuing appropriation made in 1922) | 124,663.12 | 119,812.72 | 866.61 | 3,983.79 |
| Control of insect infestations on national forests (available balance of continuing appropriation made in 1922) | 109,184.73 | 39,373.78 | 25,953.18 | 43,857.77 |
| Other continuing appropriations for regular work | 90,155.58 | 8,217.74 | 7,004.34 | 74,933.50 |
| Total | 42,180,386.11 | 35,641,632.40 | 4,552,650.64 | 1,986,103.07 |

| | | |
|---|---|---|
| Expenditures, as shown above | $35,641,632.40 | |
| Outstanding obligations, as shown above | 4,552,650.64 | |
| Total expenditure, fiscal year 1923, when all obligations are paid | | $40,194,283.04 |
| Less: | | |
| Receipts, 1923, deposited in United States Treasury to credit of miscellaneous receipts fund (see below) | $5,576,904.55 | |
| Reimbursement by dealers for cost of classifying cotton | 66,711.21 | |
| | | 5,643,615.76 |
| Net cost of regular work | | 34,550,667.28 |

Of the total expenditure of $40,200,000 for the regular work of the department, approximately $9,000,000, or 22.5 per cent, was used for research; $2,400,000, or 6 per cent, for extension; $20,500,000, or 51 per cent, for service and regulatory activities; and $8,300,000, or 20.5 per cent, for campaigns for the control or eradication of various animal and plant diseases and pests.

### DIRECT INCOME TO GOVERNMENT IN CONNECTION WITH WORK OF DEPARTMENT OF AGRICULTURE, FISCAL YEAR 1923.

Incident to the department's work during the fiscal year 1923, direct receipts aggregating $9,986,908 were covered into the Treasury, and fines were imposed and judgments recovered by the courts amounting to $247,895.57 in connection with the enforcement by the department of the regulatory acts which devolve upon it for administration and execution, as follows:

| | | |
|---|---|---|
| Receipts: | | |
| Deposited to credit of miscellaneous receipts fund— | | |
| From business on the national forests | $4,807,249.07 | |
| From other sources | 769,655.48 | |
| | | $5,576,904.55 |
| Deposited to credit of miscellaneous receipts fund but subsequently appropriated as special funds for use of Forest Service— | | |
| Ten per cent of net receipts from business on the national forests, for forest road and trail construction in 1924 | 528,569.06 | |
| Contributions from private sources, used mainly for the construction of forest roads and trails | 1,517,467.46 | |
| | | 2,046,036.52 |
| Deposited to credit of appropriations for regular work of department | | 402,588.58 |
| Deposited to credit of appropriations administered by but not used in prosecuting regular work of department— | | |
| Reimbursement for cost of distributing surplus war materials to States for use in road-construction work | $573,183.95 | |
| Repayments by farmers of seed-grain loans | 1,388,194.40 | |
| | | 1,961,378.35 |
| Total receipts | | 9,986,908.00 |
| Fines imposed and judgments recovered by the courts in connection with violations of statutes intrusted to Department of Agriculture for enforcement | | 247,895.57 |
| Total direct income to Government resulting from activities of Department of Agriculture | | 10,234,803.57 |

**FEDERAL FUNDS ADMINISTERED BY DEPARTMENT BUT NOT USED FOR ITS REGULAR WORK.**

In addition to the expenditures for conducting the investigative, regulatory, and other regular activities of the department, $88,514,578.60 was expended during the fiscal year 1923 from appropriations administered by the department but not used for the prosecution of its regular work as follows:

| | Appropriation available, fiscal year 1923. | Expenditure, fiscal year 1923. | Unexpended balance, June 30, 1923. |
|---|---|---|---|
| Extension work in agriculture and home economics: | | | |
| Provided by Smith-Lever Act of May 8, 1914 | $4,580,000.00 | | |
| Supplementary fund provided by agricultural appropriation act for 1923 | 1,300,000.00 | | |
| Balances from prior years | 154,472.77 | | |
| | 6,034,472.77 | [1] $5,810,449.45 | $224,023.32 |
| Research work of State agricultural experiment stations (provided by agricultural appropriation act for 1923) | 1,440,000.00 | | |
| Balances from prior years | 210.10 | | |
| | 1,440,210.10 | [1] 1,439,999.59 | 210.51 |
| Federal-aid road construction (provided by acts of July 11, 1916; Feb. 28, 1919; Nov. 9, 1921; and Jan. 22, 1923): | | | |
| Rural post roads— | | | |
| Appropriated for fiscal year 1923 | 25,000,000.00 | | |
| Balances from prior years | 178,703,521.43 | | |
| | 203,703,521.43 | [2] 71,601,752.72 | 132,101,768.71 |
| Roads and trails within or adjacent to national forests— | | | |
| Appropriated for fiscal year 1923 | 11,000,000.00 | | |
| Ten per cent of national forest receipts for 1922, available for road and trail building in 1923 | 338,576.96 | | |
| Balances from prior years | 6,408,586.52 | | |
| | 17,747,163.48 | 6,467,639.69 | 11,279,523.79 |

[1] Paid direct to States by Treasury Department.

[2] Including expenditures of $152,511.28 from fund of $175,000 set aside for road material investigations.

| | Appropriation available, fiscal year 1923. | Expenditure, fiscal year 1923. | Unexpended balance, June 30, 1923. |
|---|---|---|---|
| Payments to States from national forest receipts for benefit of county schools and roads..... | $882,204.01 | [1] $882,204.01 | |
| Refunds to users of national forest resources of moneys deposited by them in excess of amounts required to secure purchase price of timber, use of lands, etc..... | 101,824.19 | 101,824.19 | |
| Acquisition of lands by National Forest Reservation Commission for protection of forested watersheds of navigable streams: | | | |
| Provided by agricultural appropriation act for 1923.... | 450,000.00 | | |
| Balances from prior years..... | 1,458,455.35 | | |
| | 1,908,455.35 | 768,391.84 | $1,140,063.51 |
| Expenses of National Forest Reservation Commission (provided by act of Mar. 1, 1911): | | | |
| Appropriation for fiscal year 1923..... | 25,000.00 | | |
| Balances from prior years..... | 48,242.21 | | |
| | 73,242.21 | 537.06 | 72,705.15 |
| Cooperative work, Forest Service, consisting principally of forest road and trail construction (paid from contributions from private sources): | | | |
| Amount contributed during 1923..... | 1,517,467.46 | | |
| Balances from prior years..... | 381,495.75 | | |
| | 1,898,963.21 | 1,299,782.88 | 599,180.33 |
| Farmers' seed-grain loans: | | | |
| Appropriations provided by deficiency acts of July 1, 1922, and Mar. 4, 1923, for collection of loans..... | 75,000.00 | | |
| Collections during 1923 of loans made in 1921 and 1922..... | 1,388,194.40 | | |
| Previously collected..... | 693,173.64 | | |
| | 2,156,368.04 | 69,226.66 | 2,087,141.38 |

[1] Paid direct to States by Treasury Department.

| | Appropriation available, fiscal year 1923. | Expenditure, fiscal year 1923. | Unexpended balance, June 30, 1923. |
|---|---|---|---|
| Exchange of lands, State of Washington | $3.31 | $3.31 | |
| Work done by Department of Agriculture for other departments at their request, under authority of section 7, fortifications act of May 21, 1920: | | | |
| Allotments from other departments, fiscal year 1923 | 12,623.00 | | |
| Balance of allotments made in prior years | 62,453.35 | | |
| | 75,076.35 | 72,687.59 | $2,388.76 |
| Procuring and disposing of nitrate of soda to farmers (balance of war emergency revolving fund provided by acts of Aug. 10, 1917, Mar. 28, 1918, and Oct. 1, 1918) | 512,328.26 | 79.61 | [1] 512,248.65 |
| Total Federal appropriations administered by department but not used for its regular work | 236,533,832.71 | 88,514,578.60 | 148,019,254.11 |

[1] Turned into surplus fund June 30, 1923.

*Summary of all appropriations available to the Department of Agriculture during fiscal year 1923.*

| Title of appropriation. | Amount appropriated. | Expenditures to June 30, 1923. | Unexpended balance, June 30, 1923. |
|---|---|---|---|
| Agricultural act for fiscal year 1923 | $36,774,173.00 | $31,388,336.97 | $5,385,836.03 |
| Supplementary appropriations contained in deficiency acts of July 1, 1922, Jan. 22, 1923, and Mar. 4, 1923: | | | |
| Suppressing spread of pink bollworm of cotton | 75,000.00 | 75,000.00 | ..... |
| Fighting forest fires | 375,000.00 | 375,000.00 | ..... |
| Protection of lands in Oregon and California Railroad forfeiture suits | 16,480.00 | 13,987.61 | 2,492.39 |
| Motor boat for Alaskan forests | 8,500.00 | ..... | 8,500.00 |
| Citrus canker eradication | 100,000.00 | 100,000.00 | ..... |
| White-pine blister rust control | 30,000.00 | 30,000.00 | ..... |
| Nut culture | 5,000.00 | 5,000.00 | ..... |
| Investigating sources of crude rubber | 100,000.00 | 4,395.57 | 95,604.43 |
| Boll weevil poisoning by airplane | 40,000.00 | 29,207.54 | 10,792.46 |
| Preventing spread of Japanese beetle | 25,000.00 | 18,731.29 | 6,268.71 |
| Supplemental appropriation for increase of compensation (act of June 29, 1922) | 3,232,863.00 | 2,935,862.96 | 297,000.04 |
| Permanent specific appropriations: | | | |
| Meat inspection (act of June 30, 1906) | 3,000,000.00 | 3,000,000.00 | ..... |
| Cooperative agricultural extension work (act of May 8, 1914) | 4,580,000.00 | 4,510,449.45 | 69,550.55 |
| Cooperative construction of roads and trails, national forests (act of July 11, 1916) | 1,000,000.00 | ..... | 1,000,000.00 |
| National Forest Reservation Commission (act of Mar. 1, 1911) | 25,000.00 | 496.69 | 24,503.31 |
| Continuing appropriations: | | | |
| Cooperative construction of rural post roads (deficiency act of Jan. 22, 1923) | 25,000,000.00 | 152,511.28 | 24,847,488.72 |
| Forest highways (act of Nov. 9, 1921) | 7,000,000.00 | 342,504.53 | 6,657,495.47 |
| Forest road development (act of Nov. 9, 1921) | 3,000,000.00 | 859,919.22 | 2,140,080.78 |
| Indefinite appropriation. Refunds to depositors, national forests fund | 101,824.19 | 101,824.19 | ..... |
| Special funds: | | | |
| Roads and trails for States, national forests fund | 338,576.96 | ..... | 338,576.96 |
| Payments to States and Territories, national forests fund | 846,442.41 | 846,442.41 | ..... |
| Payments to school funds, Arizona and New Mexico, national forests fund | 35,761.60 | 35,761.60 | ..... |
| Cooperative work, Forest Service | 1 517,467.46 | 918,287.13 | 599,180.33 |
| Revolving fund for classification of cotton | 66,711.21 | 12,460.55 | 54,250.66 |
| Fund from seed-grain loans collected during 1923 | 1,388,194.40 | ..... | 1,388,194.40 |
| Appropriation for collection of seed-grain loans | 75,000.00 | 69,226.66 | 5,773.34 |
| Allotment for nitrate plants | 500,000.00 | ..... | 500,000.00 |
| Allotments from other departments: | | | |
| Insect control, Kaibab National Forest | 1,000.00 | 1,000.00 | ..... |
| Air Service, Army, 1923 | 10,000.00 | 9,797.13 | 202.87 |
| Breeding experimental animals, Army, 1923 | 1,000.00 | 753.57 | 246.43 |
| Investigations for Federal Power Commission, 1923 | 450.00 | 230.01 | 219.99 |
| Manufacture of arms | 173.00 | 140.63 | 32.37 |
| Total, current appropriations and funds (exclusive of balances from prior years) | 89,269,617.23 | 45,837,326.99 | 43,432,290.24 |

*Summary of all appropriations available to the Department of Agriculture during fiscal year 1923*—Continued.

| Title of appropriation. | Amount appropriated. | Expenditures to June 30, 1923. | Unexpended balance, June 30, 1923. |
|---|---|---|---|
| Unexpended balances of appropriations and funds for prior fiscal years remaining available for expenditure or other disposition during fiscal year 1923: | | | |
| Appropriations in agricultural acts for fiscal years 1921 and 1922 | $5,683,344.45 | $2,747,852.18 | [1] $2,935,492.27 |
| Reappropriation of unexpended balance for eradication of foot-and-mouth disease, etc | 353,924.93 | 53,392.49 | 300,532.44 |
| Supplemental appropriations for fiscal years 1921 and 1922— | | | |
| White-pine blister rust control (1922-23) | 124,663.12 | 119,812.72 | 4,850.40 |
| Insect infestations, national forests (1922-23) | 109,184 73 | 39,373.78 | 69,810.95 |
| Enforcement of packers and stockyards act | 47,410.93 | 20,497.27 | 26,913.66 |
| Enforcement of future trading act | 33,616.18 | 6,304.77 | 27,311.41 |
| Operation of Center Market | 44,552.10 | 22,219.44 | 22,332.66 |
| Salaries and expenses, wool division, War Industries Board | 2,500.00 | ..... | 2,500.00 |
| Protection of lands, Oregon and California Railroad forfeiture suits | 112.40 | 112.40 | ..... |
| Consolidating addressing and duplicating work | 33.94 | ..... | 33.94 |
| Blowndown of timber, Olympic National Forest (1921-22) | 8,421.63 | ..... | 8,421.63 |
| Supplemental appropriations for increase of compensation for fiscal years 1921 and 1922 | 138,189.81 | 125,296.55 | [1] 12,893.26 |
| Permanent specific appropriations— | | | |
| Meat inspection | 532,400.04 | 306,069.76 | [1] 226,330.28 |
| Cooperative agricultural extension work | 154,472.77 | ..... | [1] 154,472.77 |
| Cooperative construction of roads and trails, national forests | 1,136,729.49 | 651,909.18 | 484,820.31 |
| National Forest Reservation Commission | 48,242.21 | 40.37 | [1] 48,201.84 |
| Continuing appropriations— | | | |
| Cooperative construction of rural post roads | 178,703,521.43 | 71,449,241.44 | 107,254,279.99 |
| Forest highways | 2,230,127.09 | 2,230,127.09 | ..... |
| Forest road development | 1,975,242.50 | 1,975,242.50 | ..... |
| Federal forest road construction | 765,939.36 | 290,193.18 | 475,746.18 |
| Acquisition of lands for protection of forested watersheds of navigable streams | 689,221.88 | 413,223.70 | 275,998.18 |
| Enforcement of grain standards act | 2,922.10 | 1,858.51 | 1,063.59 |
| Administration of warehouse act | 6,092.98 | 5,567.04 | 525.94 |
| Determining cotton standards and spot markets | 722.26 | 487.45 | 234.81 |
| Sullys Hill National Park game preserve | 4,744.33 | 250.14 | 4,494.19 |
| Wind Cave national game preserve | 1,296.12 | 54.60 | 1,241.52 |
| Laboratory building, Arlington Farm | 74,377.79 | ..... | 74,377.79 |
| Exchange of lands, State of Washington | 3.31 | 3.31 | ..... |
| Special funds— | | | |
| Roads and trails for States, national forests fund | 300,548.08 | 117,743.99 | 182,804.09 |
| Cooperative work, Forest Service | 381,495.75 | 381,495.75 | ..... |
| Revolving fund for classification of cotton | 67,827.08 | 67,827.08 | ..... |
| Fund from seed-grain loans collected during 1922 | 693,173.64 | ..... | 693,173.64 |
| Procuring and disposing of nitrate of soda | 512,328.26 | 79.61 | [1] 512,248.65 |

[1] Of these balances, $1,702,859.80 was turned into the surplus fund of the Treasury at the end of the year.

*Summary of all appropriations available to the Department of Agriculture during fiscal year 1923*—Continued.

| Title of appropriation. | Amount appropriated. | Expenditures to June 30, 1923. | Unexpended balance, June 30, 1923. |
|---|---|---|---|
| Unexpended balances of appropriations and funds for prior fiscal years remaining available for expenditure or other disposition during fiscal year 1923—Contd. | | | |
| Allotment for nitrate plants | $275,903.46 | $212,976.17 | $62,927.29 |
| Allotments from other departments— | | | |
| Air Service, Army, 1922 | 260.73 | 260.69 | .04 |
| Breeding experimental animals, Army, 1922 | 571.60 | 78.00 | [1] 493.60 |
| Research by Forest Service in aircraft production, Army | 5.39 | | [1] 5.39 |
| Tests of forest products for Army | 36.51 | 35.26 | [1] 1.25 |
| Investigations for Federal Power Commission | 5,800.00 | 5,614.37 | 185.63 |
| Aviation, Navy, 1922 | 50,000.00 | 49,000.60 | 999.40 |
| Aviation, Navy, 1921 | 5,779.12 | 5,777.33 | [1] 1.79 |
| Total (including balances from prior years) | [2] 284,435,356.73 | [3] 127,137,345.71 | [4] 157,298,011.02 |

[1] These balances, no longer available for expenditure, totaling $502.03, were returned to the departments from which the allotments originated.

[2] Includes $5,721,137.91 in annual appropriations for regular work of department for fiscal years 1921 and 1922.

[3] Includes $2,981,134.71 expended from annual appropriations for regular work of department in payment of obligations incurred during fiscal years 1921 and 1922.

[4] Includes $2,740,003.20 unexpended balances of annual appropriations for regular work of department for fiscal years 1921 and 1922.

## REVIEW OF AGRICULTURAL PRODUCTION AND EXPORTS.

*Acreage of crops in the United States.*

| Crop. | Annual average, 1910–1914. | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 [1] | 1923 [1] (preliminary estimate). |
|---|---|---|---|---|---|---|---|---|---|---|
| CEREALS. | | | | | | | | | | |
| Corn | 105,240,000 | 106,197,000 | 105,296,000 | 116,730,000 | 104,467,000 | 97,170,000 | 101,699,000 | 103,740,000 | 102,428,000 | 103,112,000 |
| Wheat | 48,953,000 | 60,469,000 | 52,316,000 | 45,089,000 | 59,181,000 | 75,694,000 | 61,143,000 | 63,696,000 | 61,630,000 | 58,253,000 |
| Oats | 38,014,000 | 40,996,000 | 41,527,000 | 43,553,000 | 44,349,000 | 40,359,000 | 42,491,000 | 45,495,000 | 40,313,000 | 40,768,000 |
| Barley | 7,593,000 | 7,148,000 | 7,757,000 | 8,933,000 | 9,740,000 | 6,720,000 | 7,600,000 | 7,414,000 | 7,390,000 | 7,980,000 |
| Rye | 2,305,000 | 3,129,000 | 3,213,000 | 4,317,000 | 6,391,000 | 6,307,000 | 4,409,000 | 4,528,000 | 6,210,000 | 5,234,000 |
| Buckwheat | 826,000 | 769,000 | 828,000 | 924,000 | 1,027,000 | 700,000 | 701,000 | 680,000 | 785,000 | 772,000 |
| Rice | 733,000 | 803,000 | 869,000 | 980,900 | 1,118,550 | 1,063,000 | 1,336,000 | 921,000 | 1,055,000 | 883,000 |
| Grain sorghums | ..... | 4,153,000 | 3,944,000 | 5,153,000 | 6,036,000 | 5,060,000 | 5,120,000 | 4,635,000 | 5,051,000 | 5,516,000 |
| Total | 203,664,000 | 223,664,000 | 215,750,000 | 225,679,900 | 232,309,550 | 233,073,000 | 224,499,000 | 231,109,000 | 224,862,000 | 222,518,000 |
| VEGETABLES. | | | | | | | | | | |
| Potatoes | 3,686,000 | 3,734,000 | 3,565,000 | 4,384,000 | 4,295,000 | 3,542,000 | 3,657,000 | 3,941,000 | 4,331,000 | 3,892,000 |
| Sweet potatoes | 611,000 | 731,000 | 774,000 | 919,000 | 940,000 | 941,000 | 992,000 | 1,066,000 | 1,116,000 | 1,007,000 |
| Beans (commercial) | ..... | 928,000 | 1,107,000 | 1,821,000 | 1,744,000 | 1,060,000 | 847,000 | 777,000 | 1,043,000 | 1,255,000 |
| Onions (commercial) | ..... | ..... | ..... | 64,580 | 65,400 | 52,830 | 65,550 | 58,070 | 64,780 | 62,660 |
| Cabbage (commercial) | ..... | ..... | ..... | 93,090 | 111,940 | 94,300 | 121,421 | 104,060 | 136,860 | 102,070 |
| Total | 4,297,000 | 5,393,000 | 5,446,000 | 7,281,670 | 7,156,340 | 5,690,130 | 5,682,971 | 5,946,130 | 6,691,640 | 6,318,730 |
| MISCELLANEOUS. | | | | | | | | | | |
| Cranberries (3 States) | ..... | 23,100 | 26,200 | 18,200 | 25,400 | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 |
| Flaxseed | 2,402,000 | 1,387,000 | 1,474,000 | 1,984,000 | 1,910,000 | 1,503,000 | 1,757,000 | 1,108,000 | 1,251,000 | 2,285,000 |
| Sugar beets | 498,122 | 611,301 | 665,308 | 664,797 | 594,010 | 692,455 | 871,676 | 814,988 | 530,247 | 732,000 |
| Tobacco | 1,209,000 | 1,369,900 | 1,413,400 | 1,517,800 | 1,647,100 | 1,951,000 | 1,960,000 | 1,427,000 | 1,725,000 | 1,762,000 |
| All hay | 66,356,000 | 67,904,000 | 72,356,000 | 71,415,000 | 71,120,000 | 74,038,000 | 73,888,000 | 74,401,000 | 77,050,000 | 76,029,000 |
| Cotton | 35,330,000 | 31,412,000 | 34,985,000 | 33,841,000 | 36,008,000 | 33,566,000 | 35,878,000 | 30,509,000 | 33,036,000 | 38,287,000 |
| Sorghum cane for sirup | ..... | ..... | ..... | 415,200 | 421,600 | 487,000 | 536,000 | 518,000 | 448,000 | 402,000 |
| Peanuts | ..... | ..... | 1,043,000 | 1,842,000 | 1,865,000 | 1,132,000 | 1,181,000 | 1,214,000 | 986,000 | 918,000 |
| Broomcorn | ..... | 230,100 | 235,200 | 345,000 | 366,000 | 352,000 | 275,500 | 222,000 | 257,000 | 492,000 |
| Clover seed | ..... | ..... | 939,000 | 821,000 | 820,000 | 942,000 | 1,082,000 | 889,000 | 1,126,000 | 739,000 |
| Grand total | 313,756,122 | 331,994,401 | 334,333,108 | 345,825,567 | 354,243,000 | 353,451,585 | 347,636,147 | 348,183,118 | 347,987,887 | 350,507,730 |

[1] Subject to revision in December, 1923.

## *Crop production in the United States.*

[The figures are in round thousands—i. e., 000 omitted.]

| Crop. | Annual average, 1910–1914. | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 [1] | 1923 [1] |
|---|---|---|---|---|---|---|---|---|---|---|
| **CEREALS.** | | | | | | | | | | |
| Corn.....bushels.. | 2,732,457 | 2,994,793 | 2,566,927 | 3,065,233 | 2,502,665 | 2,811,302 | 3,208,584 | 3,068,569 | 2,890,712 | 3,029,192 |
| Wheat.....do.... | 728,225 | 1,025,801 | 636,318 | 636,655 | 921,438 | 967,979 | 833,027 | 814,905 | 862,091 | 781,737 |
| Oats.....do.... | 1,157,961 | 1,549,030 | 1,251,837 | 1,592,740 | 1,538,124 | 1,184,030 | 1,496,281 | 1,078,341 | 1,201,436 | 1,302,453 |
| Barley.....do.... | 186,208 | 228,851 | 182,309 | 211,759 | 256,225 | 147,608 | 189,332 | 154,946 | 186,118 | 199,251 |
| Rye.....do.... | 37,568 | 54,050 | 48,862 | 62,933 | 91,041 | 75,483 | 60,490 | 61,675 | 95,497 | 64,774 |
| Buckwheat.....do.... | 17,022 | 15,056 | 11,662 | 16,022 | 16,905 | 14,399 | 13,142 | 14,207 | 15,050 | 14,511 |
| Rice.....do.... | 24,378 | 28,947 | 40,861 | 34,739 | 38,606 | 41,985 | 52,066 | 37,612 | 41,965 | 32,737 |
| Grain sorghums.....do.... | ..... | 114,460 | 53,858 | 61,409 | 73,241 | 130,734 | 137,408 | 113,990 | 90,381 | 103,506 |
| Total..... | 4,883,819 | 6,010,988 | 4,792,634 | 5,681,490 | 5,438,245 | 5,373,520 | 5,990,330 | 5,344,245 | 5,383,250 | 5,528,161 |
| **VEGETABLES.** | | | | | | | | | | |
| Potatoes.....bushels.. | 360,772 | 359,721 | 286,953 | 442,108 | 411,860 | 322,867 | 403,296 | 361,659 | 451,185 | 416,722 |
| Sweet potatoes.....do.... | 57,117 | 75,639 | 70,955 | 83,822 | 87,924 | 97,126 | 103,925 | 98,654 | 109,534 | 97,429 |
| Beans (commercial).....do.... | ..... | 10,321 | 10,715 | 16,045 | 17,397 | 13,349 | 9,185 | 9,150 | 11,893 | 14,936 |
| Onions (commercial).....do.... | ..... | 7,664 | 8,562 | 12,376 | 19,336 | 11,398 | 23,525 | 14,440 | 19,129 | 16,503 |
| Cabbage (commercial).....tons.. | ..... | 671 | 255 | 475 | 498 | 357 | 982 | 678 | 1,117 | 824 |
| **FRUITS.** | | | | | | | | | | |
| Peaches.....bushels.. | 45,842 | 64,097 | 37,505 | 48,765 | 33,094 | 53,178 | 45,620 | 32,602 | 56,705 | 45,555 |
| Pears.....do.... | 11,184 | 11,216 | 11,874 | 13,281 | 13,352 | 15,006 | 16,805 | 11,297 | 18,661 | 15,335 |
| Apples.....do.... | 197,898 | 230,011 | 193,905 | 166,749 | 169,625 | 142,086 | 223,677 | 99,002 | 201,252 | 193,855 |
| Cranberries (3 States).....bbls.. | ..... | 441 | 471 | 249 | 352 | 549 | 449 | 384 | 568 | 619 |
| **MISCELLANEOUS.** | | | | | | | | | | |
| Flaxseed.....bushels.. | 18,353 | 14,030 | 14,296 | 9,164 | 13,369 | 7,256 | 10,774 | 8,029 | 11,668 | 19,343 |
| Sugar beets.....tons.. | 5,391 | 6,511 | 6,228 | 5,980 | 5,949 | 6,421 | 8,538 | 7,782 | 5,183 | 6,667 |
| Tobacco.....pounds.. | 991,958 | 1,062,237 | 1,153,278 | 1,249,276 | 1,439,071 | 1,465,481 | 1,582,225 | 1,069,693 | 1,324,840 | 1,436,738 |
| All hay.....tons.. | 81,640 | 107,263 | 110,992 | 98,439 | 91,139 | 104,760 | 105,315 | 97,770 | 112,791 | 102,914 |
| Cotton.....bales.. | 14,259 | 11,192 | 11,450 | 11,302 | 12,041 | 11,421 | 13,440 | 7,954 | 9,762 | 10,248 |
| Sorghum sirup.....galls.. | 14,974 | 14,823 | 13,668 | 37,472 | 33,387 | 39,413 | 49,505 | 45,566 | 36,532 | 33,643 |
| Peanuts.....pounds.. | ..... | ..... | 919,028 | 1,432,581 | 1,240,102 | 783,273 | 841,474 | 829,307 | 623,507 | 647,589 |
| Broomcorn.....tons.. | ..... | 52 | 39 | 57 | 62 | 53 | 36 | 38 | 35 | 68 |
| Clover seed.....bushels.. | ..... | ..... | 1,706 | 1,488 | 1,197 | 1,484 | 1,944 | 1,538 | 1,875 | 1,121 |

[1] Subject to revision in December, 1923.

## *Exports of domestic foodstuffs and cotton from the United States.*

[Reports of Bureau of Foreign and Domestic Commerce, United States Department of Commerce.]

| Article exported. | Annual average, 1910–1914. | Year ending June 30— | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
| Wheat.....bushels.. | 56,913,228 | 173,274,015 | 149,831,427 | 34,118,853 | 178,582,673 | 122,430,724 | 293,267,637 | 208,321,091 | 154,950,971 |
| Wheat flour.....barrels.. | 10,678,635 | 15,520,669 | 11,942,778 | 21,879,951 | 24,181,979 | 21,651,961 | 16,179,956 | 15,796,824 | 14,882,714 |
| Oats.....bushels.. | 8,304,203 | 95,918,884 | 88,944,401 | 105,837,309 | 96,360,974 | 33,944,740 | 4,302,346 | 15,987,264 | 18,573,603 |
| Rye.....do.... | 854,765 | 14,532,437 | 13,260,015 | 11,990,123 | 27,540,188 | 37,463,285 | 45,735,052 | 29,683,602 | 51,411,550 |
| Barley.....do.... | 7,895,521 | 27,473,160 | 16,381,077 | 26,285,378 | 20,457,781 | 26,571,284 | 20,457,198 | 22,400,393 | 18,192,809 |
| Corn.....do.... | 39,809,690 | 38,217,012 | 64,720,842 | 40,997,827 | 16,687,538 | 14,467,926 | 66,911,093 | 176,385,614 | 94,064,053 |
| Total, 5 cereals and flour.....pounds.. | 8,429,735,124 | 20,780,577,136 | 19,330,110,628 | 13,951,418,808 | 21,996,905,576 | 16,859,428,924 | 28,195,134,292 | 28,722,130,372 | 21,828,314,100 |
| Sugar.....do.... | 70,976,908 | 1,630,150,863 | 1,248,908,286 | 576,483,050 | 1,115,865,161 | 1,444,030,665 | 582,698,488 | 2,002,038,652 | 749,855,325 |
| Dairy products: | | | | | | | | | |
| Butter.....do.... | 4,277,955 | 13,487,481 | 26,835,092 | 17,735,966 | 33,739,960 | 27,155,834 | 7,829,255 | 7,511,997 | 9,409,837 |
| Cheese.....do.... | 4,915,502 | 44,394,301 | 66,050,013 | 44,303,076 | 18,791,553 | 19,378,158 | 10,825,603 | 7,471,452 | 8,446,321 |
| Milk (condensed)....do.... | 15,773,900 | 159,577,620 | 259,141,231 | 528,759,232 | 728,740,509 | 710,533,270 | 266,506,031 | 288,628,298 | 159,956,707 |
| Total dairy products .....pounds.. | 24,967,357 | 217,459,402 | 352,026,336 | 590,798,274 | 781,272,022 | 757,067,262 | 285,160,889 | 303,611,747 | 177,812,865 |
| Meat and meat products: | | | | | | | | | |
| Canned beef.....do.... | 9,392,122 | 50,803,765 | 67,536,125 | 97,343,283 | 108,459,660 | 31,133,918 | 10,762,986 | 3,748,486 | 2,301,499 |
| Fresh beef.....do.... | 29,452,302 | 231,214,000 | 197,177,101 | 370,032,900 | 332,205,176 | 153,560,647 | 21,084,203 | 3,993,449 | 4,077,002 |
| Pickled beef.....do.... | 32,893,172 | 38,114,682 | 58,053,667 | 54,467,910 | 45,035,641 | 32,383,501 | 23,312,856 | 26,774,124 | 24,185,263 |
| Oleo oil.....do.... | 280,224,505 | 102,645,914 | 67,110,111 | 56,603,388 | 59,292,122 | 74,529,494 | 106,414,800 | 117,174,260 | 104,956,378 |
| Oleomargarine.....do.... | 3,268,279 | 5,426,221 | 5,651,267 | 6,309,896 | 18,570,400 | 20,952,180 | 6,219,165 | 1,989,421 | 2,027,546 |
| Stearin.....do.... | 13,234,533 | 13,062,247 | 12,936,357 | 10,360,030 | 11,537,284 | 22,505,602 | 19,177,311 | 32,560,766 | 70,767,939 |
| Tallow.....do.... | 29,008,749 | 16,288,743 | 15,209,369 | 5,014,964 | 16,172,111 | 32,937,026 | 16,843,868 | 27,658,097 | 25,664,985 |
| Canned pork.....do.... | 4,227,086 | 9,610,732 | 5,896,126 | 5,194,468 | 5,273,329 | 3,261,967 | 1,118,967 | 2,263,102 | 2,761,121 |
| Fresh pork:.....do.... | 2,023,911 | 63,005,524 | 50,435,615 | 21,390,288 | 19,644,388 | 27,224,941 | 57,075,446 | 25,911,193 | 43,501,610 |
| Bacon.....do.... | 182,474,092 | 579,808,786 | 667,151,972 | 815,294,424 | 1,238,247,321 | 803,666,861 | 489,298,109 | 350,548,952 | 408,282,065 |
| Hams and shoulders.do.... | 166,813,134 | 282,208,611 | 266,656,581 | 419,571,869 | 667,240,022 | 275,455,931 | 172,011,676 | 271,641,786 | 319,186,689 |
| Pickled pork.....do.... | 48,274,929 | 63,460,713 | 46,992,721 | 33,221,502 | 31,503,997 | 41,643,119 | 33,286,062 | 33,510,146 | 40,933,756 |
| Lard.....do.... | 474,354,914 | 427,011,338 | 444,769,540 | 392,506,355 | 724,771,383 | 587,224,549 | 746,157,246 | 812,379,396 | 952,641,705 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lard, neutral.....do.... | [2] 43,571,550 | 34,426,590 | 17,576,240 | 4,258,529 | 17,395,888 | 23,202,027 | 22,544,303 | 19,572,940 | 26,494,079 |
| Lard, compounds....do.... | 67,318,857 | 52,843,311 | 56,359,493 | 31,278,382 | 128,157,327 | 44,195,842 | 42,155,971 | 30,328,176 | 11,139,730 |
| Sausage, canned.....do.... | 6,369,268 | 6,823,085 | 6,294,950 | 5,787,108 | 8,503,580 | 7,034,150 | 4,429,723 | 1,963,548 | 2,693,636 |
| Sausage, other.....do.... | ..... | 8,590,236 | 9,134,471 | 9,239,341 | 9,721,925 | 14,750,963 | 4,926,552 | 7,207,829 | 7,719,026 |
| Sausage, casings.....do.... | 33,644,928 | 14,708,893 | 6,118,060 | 6,173,578 | 13,524,093 | 24,379,414 | 29,894,681 | 27,768,795 | 20,043,425 |
| Total, 18 meat products .....lbs.. | 1,416,546,331 | 2,000,053,391 | 2,001,059,766 | 2,344,048,215 | 3,455,285,647 | 2,220,042,132 | 1,806,713,925 | 1,796,994,466 | 2,069,377,454 |
| Total of food products mentioned above..lbs.. | 9,942,225,720 | 24,628,240,792 | 22,932,105,016 | 17,462,748,347 | 27,349,328,406 | 21,280,568,983 | 30,869,707,594 | 32,824,775,237 | 24,825,359,744 |
| Cotton.....do.... | 4,419,802,157 | 3,084,070,125 | 3,088,080,786 | 2,320,511,665 | 2,762,946,754 | 3,543,743,487 | 2,811,388,710 | 3,358,878,748 | 2,626,732,147 |
| Tobacco.....do.... | 392,183,071 | 443,293,156 | 411,598,860 | 289,170,686 | 629,287,761 | 506,526,449 | 462,797,351 | 463,388,521 | 454,410,294 |
| Grand total.....do.... | 14,754,210,948 | 28,155,604,073 | 26,431,784,662 | 20,072,430,698 | 30,741,562,921 | 25,330,838,919 | 34,143,893,655 | 36,647,042,506 | 27,906,502,185 |

[1] 2-year average.

[2] 4-year average.

## PUBLICATIONS OF THE DEPARTMENT.

The accompanying table gives a summary of new and reprinted publications issued by the department during the fiscal year ending June 30, 1923.

Of the bulletins, circulars, and Yearbooks there were 477 new titles and 783 reprints, making a total of 1,260 separate titles. The total editions of these amounted to 26,519,542 copies, of which 21,649,398, or more than 80 per cent, were popular Farmers' Bulletins. The following new publications were issued during the year: 62 Farmers' Bulletins, 105 department bulletins, 57 department circulars, and 40 soil surveys.

Of the publications of a periodical and statistical nature 7,373,465 copies were printed. These publications include the "Experiment Station Record," "Official Record," "Clip Sheet," "Weather, Crops, and Markets," and the "Journal of Agricultural Research," as well as reprints from the latter publication.

*Publications issued by the Department of Agriculture during the fiscal year ended June 30, 1923.*

| Name series. | New. | | Reprinted. | | New and reprinted. | |
|---|---|---|---|---|---|---|
| | Number of titles. | Number of copies. | Number of titles. | Number of copies. | Number of titles. | Number of copies. |
| Bulletins, circulars, Yearbook, etc.: | | | | | | |
| Farmers' Bulletins | 62 | 2,226,915 | 574 | 19,422,483 | 636 | 21,649,398 |
| Department bulletins | 105 | 553,089 | 46 | 84,500 | 151 | 637,589 |
| Department circulars | 57 | 874,720 | 23 | 324,520 | 80 | 1,199,240 |
| Secretary's Annual Report | 1 | 5,000 | ..... | ..... | 1 | 5,000 |
| Soil surveys | 40 | 40,000 | ..... | ..... | 40 | 40,000 |
| Yearbooks (1921 and 1922) | 2 | 40,472 | ..... | ..... | 2 | 40,472 |
| Bureau bulletins | 8 | 30,500 | 8 | 5,000 | 16 | 35,500 |
| Bureau circulars | 1 | 2,500 | 7 | 10,500 | 8 | 13,000 |
| Statistical bulletins | 1 | 4,500 | ..... | ..... | 1 | 4,500 |
| Miscellaneous circulars | 10 | 69,000 | 3 | 28,000 | 13 | 97,000 |
| Service and regulatory announcements | 58 | 390,500 | 6 | 16,000 | 64 | 406,500 |
| Miscellaneous | 132 | 1,810,518 | 116 | 580,825 | 248 | 2,391,343 |
| Total | 477 | 6,047,714 | 783 | 20,471,828 | 1,260 | 26,519,542 |
| Periodical and information publications: | | | | | | |
| Experiment Station Record | 23 | 165,650 | ..... | ..... | 23 | 165,650 |
| Official Record | 53 | 833,200 | ..... | ..... | 53 | 833,200 |
| Clip Sheet | 51 | 255,000 | ..... | ..... | 51 | 255,000 |
| Weather, Crops, and Markets | 53 | 6,007,000 | 2 | 14,000 | 55 | 6,021,000 |
| Journal of Agricultural Research | 17 | 34,000 | ..... | ..... | 17 | 34,000 |
| Separates from Journal of Agricultural Research | 44 | 63,615 | 1 | 1,000 | 45 | 64,615 |
| Total | 241 | 7,358,465 | 3 | 15,000 | 244 | 7,373,465 |
| Grand total | 718 | 13,406,179 | 786 | 20,486,828 | 1,504 | 33,893,007 |

**LIST OF NEW FARMERS' BULLETINS, DEPARTMENT BULLETINS, AND DEPARTMENT CIRCULARS PUBLISHED DURING FISCAL YEAR 1923.**

Following is a list of new Farmers' Bulletins, Department Bulletins, and Department Circulars issued during the fiscal year 1923, classified by general subject matter. Farmers' Bulletins are indicated by "F. B.," department bulletins by "D. B.," and department circulars by "D. C."

**Bees:**

Beekeeping in the Buckwheat Regions ..... F. B. 1216
Beekeeping in the Tulip Tree Regions ..... F. B. 1222
The Insulating Value of Commercial Double-Walled Beehives ..... D. C. 222

**Birds and Game:**

Game Laws for 1922 ..... F. B. 1288
Laws Relating to Fur-Bearing Animals, 1922 ..... F. B. 1293
Beaver Habits, Beaver Control, and Possibilities in Beaver Farming ..... D. B. 1078
Migration Records from Wild Ducks and Other Birds, Banded in the Salt Lake Valley, Utah ..... D. B. 1145
Silver-Fox Farming ..... D. B. 1151
Annual Report of the Governor of Alaska on the Alaska Game Law, 1921 ..... D. C. 225
Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1922 ..... D. C. 242
Annual Report of the Governor of Alaska on the Alaska Game Law, 1922 ..... D. C. 260
The Purpose of Bird Censuses and How to Take Them ..... D. C. 261

**Cotton:**

Cotton Dusting Machinery ..... F. B. 1319
One-Variety Cotton Communities ..... D. B. 1111
Self-Fertilization and Cross-Fertilization in Pima Cotton ..... D. B. 1134
Spinning Tests of Cotton Compressed to Different Densities ..... D. B. 1135
Comparative Spinning Tests of Superior Varieties of Cotton (Grown Under Weevil Conditions in the Southeastern States; Crop of 1921) ..... D. B. 1148
Boll-Weevil Cotton in Texas ..... D. B. 1153
The Uniformity of Pima Cotton ..... D. C. 247
Grounding Cotton Gins to Prevent Fires ..... D. C. 271

**Forestry and Trees:**

Slash Pine ..... F. B. 1256
Tree Planting in the Great Plains Region ..... F. B. 1312
Utilization of Basswood ..... D. B. 1007
Longleaf Pine ..... D. B. 1061
Oleoresin Production: A Microscopic Study of the Effects Produced on the Woody Tissues of Southern Pines by Different Methods of Turpentining ..... D. B. 1064
Natural Reproduction of Western Yellow Pine in the Southwest ..... D. B. 1105
The Western Yellow Pine Mistletoe, Effect on Growth and Suggestions for Control ..... D. B. 1112

**Forestry and Trees**—Continued.
Development of Cooperative Shelter-Belt Demonstration on the Northern Great Plains ..... D. B. 1113
Lumber Cut of the United States, 1870–1920 ..... D. B. 1119
The Formation and Pathological Anatomy of Frost Rings in Conifers Injured by Late Frosts ..... D. B. 1131
Kiln-Drying Handbook ..... D. B. 1136
Forest Products Laboratory ..... D. C. 231
State Forestry Laws of 1921 ..... D. C. 239
The National Forests of New Mexico ..... D. C. 240
Forest Fires in California, 1911–1920: An Analytical Study ..... D. C. 243
Turpentine and Rosin, Distribution of the World's Production, Trade, and Consumption ..... D. C. 258

**Forage Crops:**
Important Cultivated Grasses ..... F. B. 1254
Business Methods of Marketing Hay ..... F. B. 1265
The Velvet Bean ..... F. B. 1276
How to Grow Alfalfa ..... F. B. 1283
Cowpeas: Marketing the Seed Crop ..... F. B. 1308
Alfalfa-Root Studies ..... D. B. 1087
History and Seed Production of Purple Vetch ..... D. C. 256

**Fruits:**
Apple-Orchard Renovation ..... F. B. 1284
The Handling, Shipping, and Cold Storage of Bartlett Pears in the Pacific Coast States ..... D. B. 1072
Inspection of Fruit and Vegetable Canneries ..... D. B. 1084
The Saidy Date of Egypt: A Variety of the First Rank Adapted to Commercial Culture in the United States ..... D. B. 1125
The Freezing Temperatures of Some Fruits, Vegetables, and Cut Flowers ..... D. B. 1133
Evaporation of Fruits ..... D. B. 1141
By-products from Citrus Fruits ..... D. C. 232

**Grain Crops:**
The Hard Red Winter Wheats ..... F. B. 1280
The Hard Red Spring Wheats ..... F. B. 1281
Foreign Material in Spring Wheat ..... F. B. 1287
The Bulk Handling of Grain ..... F. B. 1290
The Common White Wheats ..... F. B. 1301
The Club Wheats ..... F. B. 1303
The Durum Wheats ..... F. B. 1304
The Soft Red Winter Wheats ..... F. B. 1305
Use of Water by Spring Wheat on the Great Plains ..... D. B. 1004
Classification of American Wheat Varieties ..... D. B. 1074
Farm and Terminal-Market Prices: Wheat, Corn, and Oats ..... D. B. 1083
Methods of Winter-Wheat Production at the Fort Hays (Kansas) Branch Station ..... D. B. 1094
Some New Varieties of Rice ..... D. B. 1127
A Physical and Chemical Study of Milo and Feterita Kernels ..... D. B. 1129
Significance of Wheat Hairs in Microscopical Examination of Flour ..... D. B. 1130
Storage of Water in Soil and Its Utilization by Spring Wheat ..... D. B. 1139
Rice Experiments at the Biggs Rice Field Station in California ..... D. B. 1155

**Grain Crops**—Continued.
Influence of Spacing on Productivity in Single-Ear and Prolific Types of Corn ..... D. B. 1157
Trebi Barley, A Superior Variety of Irrigated Land ..... D. C. 208
Wild Rice ..... D. C. 229
United States Grades for Grain Sorghums. Recommended by the United States Department of Agriculture ..... D. C. 245
United States Grades for Rye. Recommended by the United States Department of Agriculture ..... D. C. 246
**Home Economics:**
Corn and Its Uses as Food ..... F. B. 1236
Farm Manufacture of Unfermented Grape Juice ..... F. B. 1264
Uses of Rural Community Buildings ..... F. B. 1274
How to Get Rid of Rats ..... F. B. 1302
Good Proportions in the Diet ..... F. B. 1313
Canaries: Their Care and Management ..... F. B. 1327
Digestibility of Cod-Liver, Java-Almond, Tea-Seed, and Watermelon-Seed Oils, Deer Fat, and Some Blended Hydrogenated Fats ..... D. B. 1033
The Whipping Quality of Cream ..... D. B. 1075
The Production of Tulip Bulbs ..... D. B. 1082
Life History of the Kangaroo Rat ..... D. B. 1091
Vitamin B in the Edible Tissues of the Ox, Sheep, and Hog ..... D. B. 1138
Absorption and Retention of Hydrocyanic Acid by Fumigated Food Products ..... D. B. 1149
Effect of Composition on the Palatability of Ice Cream ..... D. B. 1161
Some Experiments with a Boric-Acid Canning Powder ..... D. C. 237
Homemade Apple and Citrus Pectin Extracts and Their Use in Jelly Making ..... D. C. 254
**Livestock and Dairying:**
Breeds of Swine ..... F. B. 1263
Sheep Killing Dogs ..... F. B. 1268
Renting Dairy Farms ..... F. B. 1272
The Stock-poisoning Death Camas ..... F. B. 1273
Organization and Management of Cooperative Livestock Shipping Associations ..... F. B. 1292
Cost of Using Horses on Corn Belt Farms ..... F. B. 1298
Cleaning Milking Machines ..... F. B. 1315
Milk-Plant Operation ..... D. B. 973
Influence of Season of Freshening on Production and Income from Dairy Cows ..... D. B. 1071
Shrinkage of Soft Pork Under Commercial Conditions ..... D. B. 1086
Reindeer in Alaska ..... D. B. 1089
The Effects of Inbreeding and Crossbreeding on Guinea Pigs ..... D. B. 1090
Producers' Cooperative Milk-Distributing Plants ..... D. B. 1095
The Effect of Silage on the Flavor and Odor of Milk ..... D. B. 1097
A Method of Determining Grease and Dirt in Wool ..... D. B. 1100
Unit Requirements for Producing Market Milk in Delaware ..... D. B. 1101
The Detection of Hypochlorites and Chloramins in Milk and Cream ..... D. B. 1114
The Effects of Inbreeding and Crossbreeding on Guinea Pigs. III. Crosses Between Highly Inbred Families ..... D. B. 1121

**Livestock and Dairying**—Continued.
Proportioning the Ingredients for Ice Cream and Other Frozen Products by the Balance Method ---- D. B. 1123
Dry-Land Pasture Crops for Hogs at Huntley, Mont ---- D. B. 1143
Cost of Milk Production on Forty-eight Wisconsin Farms ---- D. B. 1144
The Livestock Industry in South America ---- D. C. 228
Utility Value of Purebred Livestock ---- D. C. 235
Defects in the Quality of Butter ---- D. C. 236
Food Animals and Meat Consumption in the United States ---- D. C. 241
Tuberculin Testing of Livestock ---- D. C. 249
Woolly-Pod Milkweed: A Dangerous Stock-Poisoning Plant ---- D. C. 272
**Miscellaneous:**
Farmers' Telephone Companies: Organization, Financing, and Management ---- F. B. 1245
Farm Land Available for Settlement ---- F. B. 1271
Plain Concrete for Farm Use ---- F. B. 1279
Quack Grass ---- F. B. 1307
Effect of Borax in Fertilizer on the Growth and Yield of Potatoes ---- D. B. 998
Farm Management and Farm Organization in Sumter County, Ga ---- D. B. 1034
Coal-Tar and Water-Gas Creosotes: Their Properties and Methods of Testing ---- D. B. 1036
Tests of Drainage Dumping Plants in the Southern States ---- D. B. 1067
Farm Ownership and Tenancy in the Black Prairie of Texas ---- D. B. 1068
Farm Management in Catawba County, N. C ---- D. B. 1070
Portland Cement Concrete Roads ---- D. B. 1077
Pedigreed Fiber Flax ---- D. B. 1092
By-Products from Crushing Peanuts ---- D. B. 1096
Legal Phases of Cooperative Associations ---- D. B. 1106
Tables for the Microscopic Identification of Inorganic Salts ---- D. B. 1108
Sales Methods and Policies of a Growers' National Marketing Agency ---- D. B. 1109
The Farmers' Short-Box Measuring Flume ---- D. B. 1110
Absorption by Colloidal and Noncolloidal Soil Constituents ---- D. B. 1122
The Marketing of Mill Feeds ---- D. B. 1124
The Effect of Borax on the Growth and Yield of Crops ---- D. B. 1126
The Results of Physical Tests of Road-Building Rock from 1916 to 1921, inclusive ---- D. B. 1132
Soy and Related Fermentations ---- D. B. 1152
List of Serials Currently Received in the Library of the United States Department of Agriculture, January 1, 1922 ---- D. C. 187
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# REPORTS OF CHIEFS

# REPORT OF THE CHIEF OF THE WEATHER BUREAU.

UNITED STATES DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
*Washington, September 10, 1923.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

SIR: I have the honor to submit herewith a report of the operations of the Weather Bureau during the fiscal year ended June 30, 1923.

Respectfully,

C. F. MARVIN,
*Chief of Bureau.*

A new significance is attached nowadays to the weather factor in all human conduct and operations. For centuries a topic often convenient to fill lulls in conversation and for other purposes, the present and prospective weather for a continent, almost for the whole world, is now spread before the public twice a day in all the newspapers, weather maps, and a multitude of bulletins and advices. The United States leads the world in the utility, practicability, and extent of this public service, and even the smallest progressive nation recognizes that an organized public weather service is now quite as much a necessity as, say, a postal service or a police force. This is a growth and development of the past 50 years. In the United States the general public takes the work of its Weather Bureau more or less as a matter of course. In early years its forecasts and prognostications were not taken very seriously, and its popular sobriquet of "Old Probabilities" was suggestive of the humorous estimate in which its work was generally held. That was when the bureau was a very young institution, literally in its childhood. A historian telling the life story of the bureau can easily discern its progress into sober youth and manhood. With this came a period when the public viewed its pretentions and accomplishments (or failures) with some seriousness. However, with small sympathy for the bureau's forecasters, and less understanding of the difficulties of their tasks, storms of complaints for failures prevailed throughout the land. These are written in the columns of the public press throughout the closing years of the last century.

Recognizing its limitations, undismayed by the onslaught of its critics, confident of the wonderful possibilities of its useful public service and its ability to make it worth while to the Nation—to make its work pay back to the Nation in economic benefit many hundreds of dollars for one expended on the maintenance of the work—the bureau, through its technical staff of loyal and patriotic public serv-

ants, struggled on, bettering and extending the service little by little and in many ways. What does the historian who studies the press and weather bulletins of the present day find with respect to this work? Every paper carries the message of present and prospective weather, and for those who need fuller details special bulletins convey everything known and ascertainable. The shippers of perishable foods and products are told of the hot and cold waves their shipments will encounter en route to any destination. To the great centers of population this foreknowledge permits the saving of many thousands of dollars annually in losses either of products or by damage claims, or both. Severe cold waves, heavy snows, and general storms overspread extended regions of the country time and again each year. The newspapers carry well in advance timely details of these occurrences, and livestock is sheltered, provisions made for maintaining traffic, snows removed without embarrassing blockades, and every precaution taken to minimize the ill effects which would overtake every community visited unawares by these atmospheric phenomena. Orchards are protected from frosts, and fruits and agricultural crops are saved and matured under the prompt and helpful advices of the meteorologist. In the flooded areas of the great waterways advices are given many hours, often days, and sometimes weeks in advance of the crest stages, generally to the fraction of a foot, which the flood will attain. Such floods, in changing intensities, are annual features of the river channels, and the service is performed when the need arises, year after year. Only the merchants, the engineers in control of river operations, and the agriculturists whose acres are subject to possible inundation are able to speak from personal experience of the accuracy and value of the flood warnings of the bureau. These serve to minimize the losses and destruction which, without forewarnings, would become a calamity. Meteorology and radio communication have literally transformed the navigation of the sea from a great peril to a state of relative safety, especially in coastal waters and on the high seas in reach of the daily broadcast of weather reports from coastal stations. Cargo and even passenger ships now shape their movements on weather reports. During the hurricane season of the southern seas we may safely say a captain would not leave port without the latest weather advices, if conditions were menacing, any more than he would leave without his compass or some other essential of navigation. On the Great Lakes vessels are often compelled to make shelter or tie up at dock during stormy conditions. It has been stated that any delay of this character entails an economic loss of from $50 to $100 per hour per vessel. Ignorance of the status and progress of such storms on the part of the navigators leads to an embarrassing dilema. To leave shelter too soon is to incur hazard of storm damage. To delay unnecessarily is to suffer excess of per hour loss. The local official of the Weather Bureau steps in at this point and with his command of the weather situation he is able to broadcast advices to shipping which literally save many hours of ships' time with practically no losses in safety and security. Here, again, only those actually profiting by this useful service of the bureau are aware of its great economic benefits.

With the advent of the practical navigation of the air a whole new service is now demanded, a service of flying-weather forecasts

and weather advices to aviators. This compels the bureau to extend its observations and measurements above the surface into the free air, which is being done in a very limited way at the present time by means of kites and little so-called pilot balloons.

The historian following the growth of the bureau to its present 50 years of maturity may find in the public press and like sources these and many more detailed accounts of the useful work being done.

The confidence of the public at the present time in the forecasts, warnings, and advices of the bureau has been expressed over and over again in print and statement. Evidence of it is found, moreover, in the urgent appeals from many interests and many localities for extensions and new features of service.

It need not be said that all such activities require expenditure of public funds. Instruments must be purchased and maintained in operation, offices rented, and many expenses incurred which to-day are much in excess of the same costs before the war. If we place the population of the United States, including all outlying possessions except the Philippines, at only 100 millions, 2 cents per annum from each man, woman, and child would more than pay the entire costs of maintaining the Weather Bureau work. The time has come when, with the prevailing high costs, the bureau is unable to fully maintain its work, much less meet increasing demands for service, with its present facilities. Practically every one of its more than 200 field stations is operating under the minimum number of personnel, often in crowded offices, and with no flexibility to meet temporary losses from sickness, absence on leave, and unfilled vacancies. What happens is overtime hours of work and loss of vacations, with corresponding fatigue, discouragement, dissatisfaction, and inefficiency. In these post-war times of insistent effort at curtailment of public expenditures and the securing of the maximum of efficiency and economy in Government administration, the Weather Bureau feels it can invite the closest investigation of its status. If anyone supposes the maximum return is not being given him, let him visit any one of the principal stations and ascertain for himself its program of work and service, and the low salary scale which has prevailed for years because of rigid statutory limitations and peculiar conditions of compensation established in this bureau years before the war and which still continue. Increases are necessary to maintain and extend this useful service.

The annual program and routine of the public service of the Weather Bureau is not a heritage handed down to us from the distant past or even from the last generation. It is conspicuously a creation and development of the leaders and seniors in its present personnel, including the great contributions from a small number of faithful men and brilliant meteorologists who have passed beyond. We are the generation which is passing on to our successors a highly organized and developed service. Our task, our responsibility, is to recruit and train those who are to carry on and perfect this work in the future. This will not be possible unless the salary scales and readjustments which already have been worked out by the reclassification agencies are granted. Until that is done few college-bred men and students of science, equipped intellectually to meet the requirements, will be attracted from other lines of endeavor.

When that pay scale does become operative we may hope to secure applicants for our vacancies, among whom will be those qualified for the most difficult tasks of professional weather forecasting. We must not overlook the inexorable principle that the more successful and accurate the service of professional forecasting becomes the more exacting and expectant become the public demands.

At the present day professional meteorology furnishes a fascinating and alluring career for any student interested. The sequence of weather conditions and the investigation and formulation of its laws are not to be excelled in any scientific pursuit for infinite variety of aspect, perplexing difficulties, and alluring interest.

Meteorologists are on the threshold of new discoveries in the domain of forecasting. The public receive with respect and confidence the forecasts of storms and weather for a few days in advance, but they are not satisfied that we stop at that point. Letter after letter is received from all sides asking the bureau for forecasts for seasons, for months, and even years ahead. The only answer in all such cases is that the bureau knows of no sound physical laws by which such forecasts can be made with any promise of success. It will not jeopardize the confidence it has won from the public by undertaking to do a thing it can not do well and upon a scientific basis.

There are a few perhaps more deeply versed in some other science than meteorology, such as astrophysics, sociology, geology, economics, etc., who have essayed to claim discoveries upon which a species of long-range forecasting is possible. The professional meteorologist and forecaster, however, is inclined to view such enthusiasts as irresponsible for the successful verification of such forecasts, as overoptimistic, or as bold and daring pioneers who possibly may blaze a way through the wilderness only to leave to others the difficult task of establishing sure and safe communication.

Conservatively, however, this much may be said of long-range forecasting: No scientist has or can demonstrate, I believe, that the making of weather predictions of a general character for a considerable period of time in advance transcends any basic laws of nature or is inherently impossible. That which is not *impossible* must be *possible*, and let this be the justification of those who seek to advance the science and art of meteorology in this difficult field.

## FORECAST SERVICE.

Each year now adds new demands for special forecasts and service in connection with outdoor exercises, entertainments, fairs, aviation meets, airplane flights, etc., as the confidence of the general public grows in the service the Weather Bureau is able to give. All of these demands were met and many expressions of appreciation of service rendered were received from the beneficiaries. The forecasts issued twice daily for all sections of the country and warnings of frosts, cold waves, storms, and heavy snows, whenever conditions warrant, all of which are widely and effectively distributed through newspapers, by telephone, telegraph, radio, maps, bulletins, cards and other means, meet general requirements; but the rapidly increasing utilization of weather information by

many business industries is resulting in requests for more special forecasts and direct service. The calls for such information by telephone and telegrams heavily tax the ability and facilities of the bureau. Many field offices respond to a hundred or more telephone calls a day under normal weather conditions and several times as many when unusual or destructive conditions are indicated. A considerable portion of these calls require special consideration and attention. There are nearly 200 field offices to which the public has personal and telephonic access, and the volume of special service that is given by this means alone is enormous. These calls come for the most part from business men whose interests are affected in one way or another by the weather.

One incident will illustrate the extent to which the telephone is used in serving the people by direct contact. Announcement had been made by the Weather Bureau of a hurricane in the Gulf of Mexico which was approaching the Texas coast. The manager of the telephone company in one of the coast cities reported that during the 24 hours succeeding the warning slightly more than 200,000 telephone connections were made through his office, of which number more than 100,000 were for weather information. It was necessary to assign seven operators in addition to the regular force to handle the calls.

### FRUIT SPRAY AND HARVEST WEATHER FORECASTS.

This trial forecast service, which has been conducted in New York State in the aid of spraying operations in the apple-growing districts and special forecasts in connection with harvesting, was continued during the past year with the cooperation of the local agriculturists. It was necessary to confine the work to practically the same limited areas as last year because of lack of funds, although State organizations arranged to distribute the forecasts in some additional counties without further cost to the Weather Bureau. As heretofore stated, it will not be possible to extend these services to other areas and States and to place the project on as effective basis as its great importance justifies until such time as adequate funds are provided therefor.

### HAWAIIAN FORECAST SERVICE.

Since 1918 forecasts have been issued at Honolulu for the benefit of shipping in waters contiguous to the Hawaiian Islands. This service, although handicapped because of paucity of ship reports on which the forecasts largely were based, was very successful and met with commendation from marine interests. In the spring of 1923 the service was greatly improved through the cooperation of the Navy Department in transmitting to Honolulu daily radio messages containing additional ship reports and current observations from 16 stations along the Pacific coast from Alaska to southern California. These additional reports, together with those from Midway Island, have enabled the Honolulu forecaster to chart general barometric-pressure distributions and weather conditions in the Pacific Ocean east of the one hundred and seventieth meridian and have greatly facilitated the issuing of more accurate forecasts for the Hawaiian Island district.

ALASKAN SERVICE.

An organized unit of the Weather Bureau has been in operation in Alaska since 1916, with headquarters in Juneau. A large part of the activities have been devoted to the securing of records from all accessible portions of the Territory for climatological purposes and the maintenance of stations for the taking and telegraphing of observations for forecasting requirements in the States. Twice-daily observations are obtained from 11 stations with a gratifying degree of regularity by means of radio, telegraph, and cable (in most cases a combination of the three). The active and cordial cooperation of the Signal Corps of the Army and the Office of Communications of the Navy was essential to the success of this service. These reports are of inestimable value in the general forecast work of the bureau, especially in the issuing of storm warnings for the Pacific coast and cold-wave warnings for the Middle and Western States.

It is estimated that the value of perishable products saved as the result of cold-wave warnings issued last winter for the Chicago district alone exceeded $10,000,000, although the winter was not an unusually severe one. The district forecaster, in commenting on these estimates, stated that it would have been impossible to issue these warnings so timely and accurately if no reports from Alaska had been available. The estimates were for the Chicago district alone. Many other commercial districts in which the Alaskan observations were an equal factor in issuing cold-wave warnings therefor were similarly benefited. This is cited to indicate the tremendous economic value that the service maintained by the Weather Bureau in Alaska is to the commercial and marine interests of the United States.

During the past years daily forecasts have been made only for the Juneau district of southeast Alaska. The Government railroad from Seward, on the Pacific coast, to Fairbanks, in the Yukon Valley, a distance of 470 miles, was completed during the past year. This railroad furnishes easy travel and accessibility to the most extensive and richest agricultural region in the Territory, and its completion created a demand for a forecast service. Such service was begun on January 2, 1923. The forecasts, made in the early forenoon each day, Sundays excepted, are cabled from Juneau to Seward, and are distributed by telegraph along the railroad. They are also further distributed by telephone and by publication in newspapers published at Anchorage and Fairbanks. The forecasts cover a period of 36 hours in advance and are for the Matanuska-Susitna and Tanana Valleys and contiguous coasts and the regions traversed by the Government railroad. Officials of the railroad stated that the forecasts during the winter months were of much assistance in keeping the road open and in the making of preparartions for removing snowdrifts from deep cuts.

An incidental part of this forecast service was the establishing of reporting meteorological stations at Fairbanks, Anchorage, and McKinley Park, and the transferring to Cordova of the station formerly located at Valdez. One of these stations, McKinley Park, is located in the Mount McKinley National Park, the eastern border of which extends for 30 miles along the railroad. The park contains the highest mountain peak in North America, abounds in magnificent scenery, and is likely to be one of the great attractions to tourists

from the United States. The forecast service is designed to be of benefit to these visitors.

### RADIO DISTRIBUTION OF WEATHER FORECASTS AND INFORMATION.

The distribution of forecasts, warnings, and weather information by radio was covered in some detail in the previous annual report. This work continued during the past year along the same lines, but more effective and widespread distribution was accomplished. Beginning September 1, 1922, arrangements were made with the United Fruit Co. for broadcasting and disseminating twice daily special weather bulletins from its radio station on Swan Island for the benefit of shipping in the Caribbean Sea. These bulletins consist of wind and weather forecasts for western Gulf of Mexico (west of longitude 90°), eastern Gulf of Mexico (east of longitude 90°), and for the Windward Passage. Whenever conditions warrant, the forecasts are preceded by advices and warnings regarding any storm or hurricane that may be in progress and of "northers" during the winter months. During the hurricane seasons these are added to the morning bulletins of weather observations taken at 8 a. m., seventy-fifth meridian time, at 10 stations located in Cuba, the West Indies, and on the eastern coast of Central America.

An added feature of the service from Swan Island is that signals consisting of a red pennant by day and a red light by night are displayed from the radio tower to indicate that information concerning a hurricane, a storm, or a "norther" is in possession of the radio operator, which can be obtained by boat call ashore. This service is for the special benefit of ships not equipped with wireless, although any ship so equipped may obtain the information by radio call.

Although the number of commercial and private broadcasting stations that cooperate with the Weather Bureau in disseminating forecasts, warnings, weather and crop information, etc., remains about the same, there has been a material increase in the effectiveness of the service. Cooperation with a number of small stations with limited range was discontinued and several large and more powerful stations added. To meet popular demands the information sent out by radiophone from several stations has been amplified, and now includes river forecasts and stages, conditions of highways as affected by the weather, effect of weather on crops, weather reports from the principal crop areas, special forecasts for the guidance of farmers in harvesting, etc. In many cases forecasts for several States are now broadcast from a single station. The gradual discontinuance of the smaller and less powerful stations has left the bureau with a chain of well-distributed and reliable stations, from which hearty and continued cooperation may be expected. They are so located that practically all sections of the country are assured of opportunity to obtain the forecasts satisfactorily and directly. It is impossible to approximately estimate the number of people being served in this way. In addition to the hundreds of thousands of receiving-set owners who receive the forecasts by radiophone, large numbers of whom can obtain them in no other way, many repeat them to their neighbors by telephone. This latter form of service has become so potential that arrangements are in hand for a definite form of organization which will replace the telegraphing of forecast messages now

sent to centers for distribution. It is expected that more effective service will be accomplished thereby and that considerable economy will result.

Broadcasting by radiophone from the Arlington naval radio station (NAA) of weather forecasts and warnings for each of the States comprised in the Washington forecast district was inaugurated February 15, 1923. Broadcasts are made three times daily—at 10.05 a. m., 3.45 p. m., and 10.05 p. m., respectively, on a wave length of 435 meters. A general forecast covering the entire district and such storm and flood warnings as are issued for any portion thereof are included. On Saturdays there is included in the 3.45 p. m. broadcast the weather outlook for the ensuing week, Monday to Saturday, inclusive, for the North and Middle Atlantic States, the South Atlantic and East Gulf States, the Ohio Valley and Tennessee, and the region of Great Lakes. On Wednesdays, March 15 to November 30, inclusive, a summary giving the effect of the weather on crops during the preceding seven days ending at 8 a. m. Tuesday is given in the 10.05 a. m. and 7.45 p. m. broadcasts. A feature of the service from Arlington, which provides for dissemination of the weather forecasts immediately after they are issued, is that the announcements are made directly from the Weather Bureau office in Washington, which is connected by telephone with the radiophone transmitting apparatus at Arlington, Va.

#### STORM-WARNING SERVICE FOR THE NORTH ATLANTIC OCEAN.

The need for a storm-warning service for the North Atlantic Ocean was quite conclusively demonstrated during the past winter. Not for many years were the cyclones in that region so intense and so frequent. They caused delayed voyages, much damage to ships and cargoes, and distress to passengers. The experiences of vessels caught in these storms occupied much space in the public press. The following is quoted from an editorial in the Philadelphia Public Ledger of January 8, 1923, in reference to storms in the North Atlantic:

> One naturally may ask: What are we going to do about the cyclones in order to lessen the danger to navigation and to increase the comfort of the passengers? It will, for obvious reasons, be impossible to divert the storms to other courses or to diminish their severity. The only possible thing to do is to give warning of their presence, their intensity, and their direction of travel that vessels may steer clear of regions of violent winds. This can be done, as has been demonstrated by meteorological work on board the French steamship *Jacques Cartier*, which during its last several trips on the Atlantic has acted as a floating meteorological forecast and distributing center.

The Weather Bureau has followed with much interest the pioneer work of the French steamship *Jacques Cartier*, referred to in the editorial. This ship is engaged in general freight carrying and is commonly in service between European and American ports. Its distinctive feature is that it is also used as a school for the training of officers for the merchant ships of its owning company, about 50 cadets being continually under instruction. The training course includes all phases of navigation, commercial and international marine law, astronomy, and a thorough course in theoretical and applied meteorology. A weather-forecast and storm-warning service is conducted as an incidental part of the instruction in meteorology. The

latter project has the cooperation and support of the French Meteorological Service. The ship makes about three voyages a year, mostly to southern ports. Consequently it renders only intermittent service and is only occasionally on northern routes, for which there is the greatest demand and need for weather forecasts and information. The forecasts issued from the *Jacques Cartier* are based upon United States Weather Bureau bulletins containing observations from stations in the United States and Canada, upon similar European reports broadcast from the Eiffel Tower in Paris, and upon reports collected from ships at sea. The forecasts and warnings are distributed by radio twice daily for the benefit of ships of all nations that are within range.

The Weather Bureau received an invitation to have a representative take passage on the *Jacques Cartier* for the purpose of observing and reporting on the meteorological work conducted thereon. It was accepted, and last spring the supervising forecaster of the Weather Bureau made a trip on the ship from the United States to France and return. He reported that the work was an unqualified success, that its accomplishments demonstrated quite conclusively that a forecast service for the ocean is feasible, of great economic value, and that there is much need therefor, especially on the North Atlantic.

Continuous service of this character would require the utilization of at least three vessels and would involve no interference with their regular voyages and traffic. Continuous service is necessary to keep vessel masters informed at all times as to the wind and weather conditions along the routes they are traveling; advise them as to the location, intensity, and direction of movement of storms which might cause damage to ships and cargoes or at least retard progress; enable them to avoid such storms as far as possible; enable them to lay out ship work en voyage and to take advantage of fair weather and smooth seas for painting and other outside work; give them information of wind and weather conditions to be expected at ports of destination, thereby preventing unnecessary delays, and in other ways provide useful and advantageous information.

The plans for such service have been worked out and submitted to the United States Shipping Board. They have met with approval of that organization, which has offered cooperation in the way of providing facilities on the necessary number of Shipping Board vessels running regularly on the northern routes between the United States and Europe. The bureau is alert to the inauguration of some service of this character at the first opportune occasion.

The total reported flood losses during the year were $36,591,362, while the value of portable property saved by flood warnings was given in admittedly incomplete returns as $4,240,465.

### ADMINISTRATIVE FEATURES.

Changes in organization and administration during the year were few and not of great consequence. Several stations of observation were discontinued and others established with decreased cost of operation.

While the river service east of the Missouri is virtually sufficient for present needs, the reverse is the fact for the great territory to the

westward. The natural and steady expansion of the great agricultural and commercial interests, together with the attendant increase in population, reasonably requires a proportionately increased service if the legitimate requirements of the people are to be fulfilled. We need hundreds, yes thousands, of additional river stations. The cost of a rainfall station is about $12, with practically no maintenance cost except depreciation on equipment. The original cost of a river station will average about $100, with an annual maintenance cost of about $15. Owing to present program of economy no increases of consequence are contemplated at this time.

For several years the mountain snowfall service has been in need of a complete reorganization. This service is maintained in the mountain regions of the far West in order to provide farmers and others reliable information as to the amount of water that may be relied upon each year for irrigation and hydroelectric purposes, and the constantly increasing demands for more accurate and comprehensive service have exceeded our ability to supply under present conditions. Intensive work of the most approved character is highly necessary but must await the appropriation of the requisite funds.

### RESEARCH WORK.

During the year schemes for forecasting river stages and floods have been completed for the Willamette River system of Oregon, the Connecticut River, and the Brazos River of Texas. Other schemes will be undertaken as time will permit, mainly for the smaller rivers, as those for the larger rivers and their tributaries are virtually complete, although some need revision from time to time.

## RIVERS AND FLOODS.

The outstanding floods of the year were those in the Arkansas River from eastern Kansas to the mouth, the Neosho River of Kansas and Oklahoma, and the Cimarron and North Canadian Rivers of Oklahoma. Four weeks of almost continuous and frequently excessive rains brought about these floods, and the crest stages were, as a rule, higher than any previously recorded. Coming as they did at a season of matured wheat and growing corn and other crops, and covering in southeastern Kansas and northeastern Oklahoma alone nearly 900,000 acres of highly productive lands, the floods caused loss and damage, very incompletely reported, to the value of $27,884,200, of which by far the greater portion was in crops, matured and prospective. During the great Mississippi Valley floods of 1922 the total losses as reported were $17,087,790, nearly $11,000,000 less than in the Arkansas and Canadian Valley floods, but the former flood came before the planting season had well set in, and, furthermore, the lands were protected by high levees.

No flood warnings, however accurate and timely, can prevent loss of crops and damage to fixed property, but movable property, especially livestock, can be secured, and it is a pleasure to say that during this Arkansas Valley flood livestock and other property to the value of $1,850,000 were reported as having been saved by the flood warnings of the Weather Bureau.

A demand for the extension of the cattle-region service over important western grazing districts continued. Extension of service should also be made to some important grain States in the corn and wheat region, but increases in funds are needed for these extensions.

## FRUIT FROST WORK.

This service is of great value to the citrus growers of southern California, who are strongly organized to combat frost conditions and accomplish the saving of much fruit during periods of critical weather conditions. The minimum temperature forecasts and special frost warnings during the current year were remarkably accurate. The various fruit growers' exchanges cooperated extensively with the bureau during the past year in giving financial and other assistance.

After the close of the frost season in southern California, the special bureau representatives rendered excellent service in the San Joaquin Valley (Fresno-Lindsay district), the Santa Clara Valley (San Jose district), the Napa Valley (Winters district), the Rogue River Valley (Medford district), and in the fruit sections of eastern Washington.

Other fruit frost activities were conducted during the year as follows:

New Mexico, Roswell.—Much interest was shown in the work, and nearly all orchards are equipped with frost-fighting devices.

Arizona, Yuma.—A temperature survey was continued, primarily in the interest of the citrus industry in this vicinity, which is a growing one.

Colorado.—Fruit frost work continued in the Gunnison and Uncompahgre Valleys in the vicinity of Delta and Montrose, Colo. (Denver district), the Colorado River Valley in the vicinity of Grand Junction, and in the Canyon City fruit district (under Pueblo). The work was conducted in a satisfactory manner, and the minimum temperature forecasts and special frost warnings were satisfactorily verified.

New Jersey, New Lisbon.—The work in this district was maintained by the official in charge at Philadelphia, Pa., but no special representative was assigned to New Lisbon.

Kansas, Wichita.—The three stations recently established in this district were maintained during the year.

Florida.—Fruit frost work was continued at the same centers where it was in operation last year, namely, Jacksonville, Pensacola, and Tampa, the work being conducted by the maintenance of special stations along practically the same lines as previously.

Illinois, Peoria.—Service in the vicinity of this station was maintained as during the previous year, four special cooperative fruit stations being operated.

Missouri.—Fruit frost centers were maintained at St. Joseph and Springfield, Mo., and special warnings furnished to fruit growers.

## COOPERATION.

A number of committees, consisting of representatives of the various bureaus of the department, were appointed by the Assistant Sec-

retary of Agriculture during the year to cooperate with State colleges of agriculture and extension services in agricultural activities, the chief or assistant chief of the division of agricultural meteorology being designated a member of each. These committees were appointed and worked chiefly during the latter part of the year, and their activities were progressing at its close. They were as follows:

RANGE COMMITTEE.—Data bearing on the range problem relating to the work of the Weather Bureau were prepared and submitted to the general committee.

RANGE EXTENSION TEACHING COMMITTEE.—A range handbook is under preparation. Weather Bureau data for inclusion in this have been submitted.

SPRING-WHEAT REGION COMMITTEE.—The assistant chief of division attended a conference of the Spring Wheat Regional Council at St. Paul, Minn., in January, 1923, at which it was decided to prepare a bulletin showing the physical characteristics of the spring-wheat region, about one-third of which should be devoted to climate; at the close of the year the preparation of the climatic section was well advanced.

OZARK COMMITTEE.—Weather Bureau material has been submitted for use of this committee.

COTTON COUNCIL.—Two subcommittees of the Cotton Council are working, namely, Forms and Functions of Local Associations and Statistical Investigations. This division is represented in both of these committees.

EXTENSION COMMITTEE.—This committee has made a final report to the Assistant Secretary, which includes a recommendation that each major bureau of the department detail an employee to give his entire time to extension problems, to be financed by the Extension Service.

Some preliminary arrangements were made for cooperation with the extension agents of the department in educational work in meteorology, i. e., informing the farmer and the business man what the Weather Bureau has available that would be of assistance to them and how it may be obtained. A trip was made by the official in charge through the Southeast and in some of the States east of the Mississippi River to acquaint the extension agents and others with the nature of our products, and to formulate plans whereby the information could be distributed in the most expeditious and widest manner possible.

## PUBLICATIONS.

The following papers, prepared either by employees of the division, or by station officials cooperating, were published during the year:

Influence of Weather on the Yield of Crops. J. Warren Smith. Monthly Weather Review, November, 1922.

Frost Fighting in the Pecos Valley. C. Hallenbeck. Monthly Weather Review, January, 1923.

Predicting Minimum Temperatures. W. J. Bennett. Monthly Weather Review. February, 1923.

Precipitation of Africa. Research Series No. 13, American Geographical Society. (Included with Vegetation and Soils, by H. L. Shantz and C. F. Marbut.) By J. B. Kincer.

The Climate of the Great Plains as a Factor in Their Utilization. Read by J. B. Kincer at the annual meeting of the American Geographers, Ann Arbor, Mich., December, 1922, and published in the annals of that association.

## AGRICULTURAL METEOROLOGY.

The regular weekly summaries of weather conditions and their effect on the advance of vegetation and farm operations were published, as during the preceding year, through the medium of the department bulletin entitled "Weather, Crops, and Markets." During the crop-growing season the weekly corn and wheat region bulletin was continued at Chicago, and a similar bulletin issued at New Orleans covered conditions in the Cotton Belt. The various section centers also issued weekly State summaries as usual, in most cases throughout the year.

At the more than 200 principal stations of the Weather Bureau the uniform policy is to secure station offices and quarters in Government-owned buildings free of rent wherever practicable. However, owing to conditions that fail to furnish satisfactory exposure for instruments, or otherwise provide suitable quarters for the bureau, it is necessary to rent offices in many cases. The following tabulation indicates conditions as of July 1:

## STATIONS AND ACCOUNTS DIVISION.

*Status of Weather Bureau offices at stations outside of Washington.*

| | | |
|---|---|---|
| Free quarters and accommodations: | | |
| Observatory buildings (owned and controlled by the Weather Bureau) | 46 | |
| State university buildings | 5 | |
| Federal buildings | 78 | |
| Total free of rental | | 129 |
| Rented buildings, etc., owned by individuals or corporations: | | |
| Office buildings | 90 | |
| Buildings with kite-flying fields, aerological | 6 | |
| Total number rented buildings partly or wholly occupied | | 96 |
| Total | | [1] 225 |

The foregoing does not include Weather Bureau buildings at Narragansett Pier, R. I., and Mount Weather, Va., which continue unoccupied in charge of caretakers.

Special meteorological station at Valdez, Alaska, was discontinued March 31, 1923, and removed to Cordova, Alaska, where free office quarters were obtained. Telegraph-line repair station at Twin, Wash., was discontinued June 30, 1923.

### LEASED QUARTERS.

Existing leases for office quarters and accommodations at 24 field stations of the bureau expired by limitation June 30, 1923. These involved a total annual rental, as heretofore paid, of $19,371.36. In taking up the matter with lessors in each case it was found that at 13 of the stations new leases could be had at the same price as hereto-

[1] Three stations have quarters in two buildings, viz, Cape Henry, Va., two Weather Bureau; Cincinnati, Ohio, and Oklahoma, Okla., Weather Bureau and Federal.

fore, while at some of the remaining 11 stations exorbitant rentals were demanded, in one instance as much as 150 per cent increase, bringing the total to $25,082.64, an increase of $5,711.28. After extended negotiations office space was reduced and compromises effected whereby new leases were executed for these 24 stations at a total cost of $22,794 for next fiscal year, an increase of $3,422.64, a clear saving to the bureau of $2,288.64 over and above rentals as originally demanded and keeping within the limits of the appropriation. Enforced removals were made at Tacoma, Wash., and Dayton, Ohio, due to building operations, and rental of roof of an adjoining high building for exposures of instruments at Dubuque, Iowa ($100 per annum), is included in the above total.

#### FEDERAL BUILDINGS IN RELATION TO ADJACENT HIGHER COMMERCIAL BUILDINGS.

Federal buildings at places where the Weather Bureau has field stations generally are not more than three or four stories, and it is rare that suitable exposures for Weather Bureau instruments are available thereon. In recent years, and especially during 1923, the erection of higher commercial buildings in the vicinity of Federal buildings thus occupied has seriously interfered with the exposures of recording instruments. Funds for moving from free quarters to a rented building are in depleted condition, and in order to obtain proper exposures of instruments for meterological observations which are of paramount importance it has been necessary in some instances to place the instruments on higher adjoining buildings, with electrical connections to registers in the office of the Government building, thereby avoiding payment of high rentals for office quarters.

#### REPAIRS AND UPKEEP OF WEATHER BUREAU BUILDINGS.

Only a few repairs were made to the buildings and grounds owned by the Weather Bureau during the year owing to limited funds. Repairs and repainting have necessarily been postponed from year to year and must now be taken up to insure proper preservation of this property.

Among the more important repairs and improvements effected during the year were those at Tatoosh Island, Wash., where a combined water-supply and electric-light equipment was installed, cistern water being the only available supply at this isolated place. This is collected from the roof of the observatory building and pumped into an elevated tank. Electric light (110-volt direct current) is furnished for the buildings and will also be utilized for storm-warning displays, all greatly improving the usefulness and efficiency of this important station located at the Pacific Ocean entrance to the Strait of Juan de Fuca.

At Sandy Hook, N. J., the two-story brick building erected August, 1914, has never been satisfactory as an observatory and residence for the official in charge due to porosity of exterior walls causing interior dampness. Applications of fluorspar compounds having failed to make the structure waterproof, the entire surface of the building was given two coats of magnesite stucco. Work was completed December, 1922, with effective results since.

Needed storage buildings were erected on the reservations at Cape Henry, Va., Burlington, Vt., and Abilene, Tex.

Conditions at Cape Henry, Va., were also greatly improved during the year by connections with the Norfolk Southern Railroad power line, thus securing better electric-light service for Weather Bureau buildings and storm-warning night displays made at that place.

### SURPLUS BUILDINGS AND PROPERTY.

Weather Bureau buildings and grounds at Narragansett Pier, R. I., and Mount Weather, Va., remain surplus and unoccupied, in charge of caretakers. The sale, disposition, or rental of this valuable Government property has not been authorized as yet. Cost of only the most urgent repairs and upkeep amounted to about $2,500 per annum, which expense is necessary in order to keep the property from being rendered wholly worthless. In the interests of economy and good business management something should be done in the matter without further delay.

## TELEGRAPH DIVISION.

Telegraphic transmission conditions throughout the country during the year were what may be considered as normal, although general use of the multiplex system for message business by the principal telegraph company, instead of "hand" sending which prevailed previous to the war, reduced efficiency in some sections. This latter method, however, is still used for forwarding "circuit" reports, and the system was maintained at a uniformly high standard, despite varying weather conditions of adverse character.

Local service was performed during the first half of the year with difficulty, owing to shortage of operators due to resignations of trained men because of inadequate compensation and to harassing delays in securing successors. This situation resulted largely by reason of the low salaries paid by the Weather Bureau as compared with the more attractive ones which commercial establishments are enabled to offer for the services of first-class telegraphers. Equalization and adequate pay will doubtless ensue when reclassification becomes effective; meanwhile, further losses may be expected and are imminent.

Performance of the audit work of the division suffered somewhat until the disturbing conditions above referred to were remedied. Earnest and continuous efforts by the division force during the winter, however, brought this work up to date in the late spring. No opportunity occurred for revision and improvement of division records and other nonessential activities of a desirable character referred to in the last report which have lain dormant since the immediate post-war period because of frequent and long-continued losses in personnel.

Contracts were renewed on favorable terms with the various telegraph, telephone, wireless, and cable companies, with the exception of one telegraph company, with which there has been no formal agreement for several years, although the rates for service named in the last executed contract are continued indefinitely by informal agreement.

An important element of the communication service during the hurricane season is the prompt reception of cable messages from the

West Indies and the coasts contiguous to the Gulf of Mexico and the Caribbean Sea and of wireless messages from ships in these and Atlantic waters. The cable service was fairly good, but, as heretofore, inordinate delays in receipt of ship messages were experienced, largely due to static electricity which prevails during the summer months. It is not likely much improvement will occur until this handicap to prompt transmission is eliminated.

### WEATHER BUREAU TELEGRAPH AND TELEPHONE LINES.

On the whole, these lines served satisfactorily the purposes for which they were constructed, namely, transmission to and from isolated stations on the Atlantic and Pacific coasts and in Lake Michigan, of meteorological reports, storm warnings, vessel and wreck reports, and miscellaneous Government and commercial messages.

The conductor used for many years for telegraphing in the submarine cable connecting Block Island, R. I., with the mainland, however, developed trouble for a while in the fall of 1922 and became permanently disabled on March 26 last. The Coast Guard immediately offered to attempt repair, but because of unforeseen troubles appearing in the machinery of the cable ship, repair was necessarily deferred for several months. In the meantime all telegrams had to be telephoned to and from the island. The conductor was repaired on July 1 and is now giving good service. It is liable, however, to break down at any time because of progressive electrolysis. In order that the large amount of telegraph and telephone business offered, especially in the summer, may be adequately taken care of, a new cable of greatly increased capacity should be laid by a commercial company immediately. This situation was presented several years ago to the presidents of the commercial companies directly interested without result. Two of the three conductors in this cable are leased to the New England Telephone & Telegraph Co. for telephone purposes, and it is only a question of time when the Weather Bureau will be compelled to terminate the lease and to assume entire control and operation and to build or lease land lines on the island and mainland in order to connect with a telegraph office.

Three other cables owned and operated by the bureau as telephone lines, viz, those connecting Beaver Island and North and South Manitou Islands, Lake Michigan, with the mainland, worked without interruption during the entire year. The line from Point Reyes to San Anselmo, Calif., connecting at the latter point with San Francisco via the Pacific Telephone & Telegraph Co., is also operated telephonically. General conditions were improved by a rerouting of 13 miles of the line and by substituting copper wire for the old galvanized-iron wire formerly in use. The 10-mile telephone line between Whitefish Point and Vermilion Point, Mich., was turned over to the Coast Guard March 1, which has supplied and now owns practically all the present material.

Two remaining lines are operated telegraphically, that between North Head and Fort Canby, Wash., 2½ miles, connecting with Portland, Oreg., by way of a War Department cable across the Columbia River, thence by Western Union wire from Fort Stephens, and the line from Tatoosh Island to Port Angeles, about 90 miles in length. These are not only vitally important to the Weather Bureau and other

Government interests, but also carry a large volume of commercial business.

Under changed operating conditions across the Columbia river, displacing the cooperative arrangement with the Western Union Telegraph Co. effective for many years, the Weather Bureau now pays for all business transacted beyond Fort Canby, the tolls amounting to about $500 per annum. No revenue accrues to this line, except $90 per annum for its use by the telegraph company for commercial business.

Frequent reconstruction and repair work has always been necessary on the Tatoosh-Port Angeles line because of its location in rough woodland territory. Devastation by heavy storms which occur during the winter and spring and damage resulting from logging operations constitute the chief causes of trouble. The usual amount of this work was accomplished during the past year. The winter repair station at Sekiou, midway between Clallam Bay and Neah Bay, and that at Twin were closed June 30. The repair work of the sections will be done by employees at the stations on each side, thus enlarging the areas of the several sections concerned and reducing to some extent operating costs. Rerouting and improving the county roads is still in progress, and as this work is completed in a section relocation along these roads of the telegraph line follows.

The Government receipts from all lines for commercial messages handled during the year amounted approximately to $4,853. Expenses of labor and material for repair, reconstruction, and relocations amounted approximately to $4,000.

NORFOLK-CAPE HENRY-HATTERAS (VA.-N. C.) SECTION (TELEGRAPH).

Owing to imperfect wire conditions south of Coast Guard station No. 179 during the first half of the year, considerable trouble was experienced in transmitting the large volume of business transacted over this line. During the latter half of the year 19 miles of new wire was strung, many poles reset, and new insulators installed over portions of this section, resulting in further improved operating conditions. The line is now in almost perfect working order, and when additional new insulators and poles are installed, which it is expected will be done in the near future, the line should be in excellent condition throughout its length of approximately 170 miles.

A new pole line was constructed and new copper wire strung for a distance of 1½ miles across New Inlet, which has completely filled up. This installation takes the place of a cable heretofore used for transmission across the inlet. The cable will be allowed to remain in place to be used in emergency cases.

Some short but necessary changes were made in the route of the line through the lighthouse reservation at Cape Henry and through the schoolhouse grounds at Hatteras.

Six hundred yards of line were blown down about 200 miles south of Cape Henry in April. Temporary repairs were made at once, but permanent reconstruction work will be deferred until the coming autumn. Three hundred poles and accessories were purchased during the year, the greater part of them having already been used in the reconstruction work above noted.

The line has been brought to its present satisfactory condition through the fine cooperation of the Coast Guard, which is largely interested in the upkeep of the pole line, as a metallic telephone circuit is maintained thereon, connecting near the Hatteras station with the Coast Guard line to Morehead City, N. C.

WHITEFISH POINT-VERMILION POINT (MICH.) SECTION (TELEPHONE).

For a number of years past replacement of poles and wire have been made by the Coast Guard and at its expense as the old materials became unserviceable. As practically none of the original line remained, jurisdiction and control of the present line was turned over to the Coast Guard on March 1, 1923.

BEAVER ISLAND-CHARLEVOIX (MICH.) SECTION (TELEPHONE); NORTH AND SOUTH MANITOU-SLEEPING BEAR POINT (MICH.) SECTION (TELEPHONE).

These lines, consisting of both cable and land lines, although constructed 18 and 20 years ago, respectively, worked satisfactorily throughout the year. The Manitou lines are operated by Coast Guard officials, who perform the necessary occasional work of repair and upkeep, the materials for which are supplied by the Weather Bureau.

POINT REYES-SAN ANSELMO (CALIF.) SECTION (TELEPHONE).

This line connects through the San Anselmo exchange of the Pacific Telephone & Telegraph Co. with the Weather Bureau office in San Francisco, and is used for transmission of meteorological observations, vessel and wreck reports, forecasts, and storm warnings. The Lighthouse and Coast Guard Services also have large need for its facilities, and the latter contributes extensively to its maintenance. No commercial messages are handled. In February a section of 13 miles of wire was transferred from poles of the Western Union Telegraph Co. to those of the Pacific Telephone & Telegraph Co., thus affording improved auditory and maintenance conditions, copper wire having been substituted for galvanized-iron wire. Number of messages handled by the Weather Bureau, 1,481; cost of Weather Bureau of upkeep, $8.64.

ALPENA-MIDDLE ISLAND-THUNDER BAY ISLAND (MICH.) SECTION (TELEPHONE).

But little interruption occurred on either of these lines, except during a portion of the winter and in June. This was caused by a defective connection in the Alpena local exchange.

During the year some repairs were made costing $97, but the extensive reconstruction contemplated as referred to in the last report has been deferred, with the expectation of accomplishing it during the coming autumn.

By means of the two lines of 27½ miles in length, including 5½ miles of submarine cable, marine interests are greatly benefited, as they not only enable the bureau to display storm warnings, but also to obtain accurate information regarding weather conditions from each point for dissemination.

NORTH HEAD-FORT CANBY (WASH.) SECTION (TELEGRAPH).

Since January 1 of this year the reciprocal arrangement between the Weather Bureau and the Western Union Telegraph Co. for service between Portland and North Head became inoperative because of the decision of the War Department to assess the latter company a definite annual sum for use of its cable across the Columbia River for transmission of commercial business. Previously the telegraph company had free use of cable facilities, first of the Weather Bureau cable and later of the War Department cable, in return for free use by the Weather Bureau of wire facilities between Fort Stevens and Portland. This change has not affected transmission of Weather Bureau business, which continues to be transacted directly between the Weather Bureau offices at North Head and Portland, but greater cost is entailed.

The Weather Bureau land-line facilities between Fort Canby and North Head are utilized by the telegraph company for a nominal consideration. Interruption between North Head and Portland totaled 175 hours, nearly all of which occurred on the Washington side of the Columbia River.

Commercial business increased greatly during the last three months of the year, owing to better facilities for communication with Alaska and with ships having been provided in the rebuilding of the naval radio station at North Head, with which the Weather Bureau wire connects.

It seems unnecessary to give detailed accounts of the several lines operated by the bureau, as these have been given in previous reports, and conditions are not materially different at the present time. A list of the lines, however, is given below.

*Block Island and Matunuck Beach, R. I.*—Telegraph line, two-wire, leased to commercial company for telephone communication.
*Norfolk-Cape Henry, Va., and Hatteras, N. C.*—Telegraph line.
*Whitefish Point and Vermilion Point, Mich.*—Telephone line.
*Beaver Island and Charlevoix, Mich.*—Telephone.
*North and South Manitou and Sleeping Bear Point, Mich.*—Telephone.
*Alpena, Middle Island, and Thunder Bay Island, Mich.*—Telephone.
*Point Reyes and San Anselmo, Calif.*—Telephone.
*North Head and Fort Canby, Wash.*—Telegraph.
*Tatoosh Island and Port Angeles, Wash.*—Telegraph.

## AEROLOGICAL INVESTIGATIONS.

Free-air observations by means of kites and balloons were continued throughout the year. This work has become an important integral part of the Weather Bureau's program.

Kite Stations.—Observations with kites were made regularly at Broken Arrow, Okla.; Drexel, Nebr.; Due West, S. C.; Ellendale, N. Dak.; Groesbeck, Tex.; and Royal Center, Ind. Kite flights are made daily, whenever possible, and in addition, when conditions are favorable, continuous series of flights are made for periods of 24 to 36 hours. Records of air pressure, temperature, humidity, and wind are thus obtained.

Pilot-Balloon Stations.—Observations by means of pilot balloons were made at the six kite stations, above listed, and at Burlington, Vt.; Denver, Colo.; Ithaca, N. Y.; Key West, Fla.; Lansing,

Mich.; Madison, Wis.; San Francisco, Calif.; San Juan, P. R.; and Washington, D. C. The observations are made twice daily at the six kite stations and at Key West, Fla., and Washington, D. C., and once each day at the remaining stations, and the computed wind conditions at various heights are telegraphed to district forecast centers at Washington, D. C.; Chicago, Ill.; and San Francisco, Calif.; where they form the basis for "flying weather" forecasts issued to the military, naval, and postal aviation services.

Special observations have been made, when requested, for use in connection with long-distance flights, free-balloon races, etc.

Observations with two theodolites have been continued, whenever opportunity afforded, in order to check the accuracy of the formula for rate of ascent of balloons and the behavior of the balloons themselves at high altitudes. These observations have shown that the revised rate of ascent formula gives extremely reliable results, except when there are pronounced vertical movements in the atmosphere. Even then the error is appreciable only in the lower layers.

Cooperation.—Effective cooperation with the Army and Navy meteorological services has been continued throughout the year. Each of these services maintains a number of pilot-balloon stations, whose primary purpose is to furnish data of immediate local interest to aviators at flying fields. These observations are also telegraphed to district forecast centers of the Weather Bureau for use in issuing "flying weather" forecasts. They thus supplement, in a very helpful way, the observations made at Weather Bureau aerological stations. In addition to the stations in the United States proper the Navy maintains one at Santo Domingo, Dominican Republic, and one at Coco Solo, Canal Zone, which, together with those of the Weather Bureau at San Juan, P. R., and Key West, Fla., furnish information of value in connection with the development and movement of hurricanes. A much larger number of stations is necessary, however, to make this service as effective as it should be.

In cooperation with representatives of the United States Air Service, the air-mail flight records for one year were analyzed and studied in connection with the Weather Bureau's kite and balloon data, and the results of this investigation were published under the title "The Wind Factor in Flight: An Analysis of One Year's Record of the Air Mail."

The official in charge of aerological investigation is the Weather Bureau representative on a sectional committee that is preparing an aeronautical safety code. The committee is composed of representatives of the Departments of War, Navy, Commerce, and Post Office, the Society of Automotive Engineers, the National Aeronautical Association, and aircraft manufacturers. The code, when completed, will provide regulations for the design and manufacture of aircraft, qualifications of pilots, establishment of airdromes and airways, and dissemination of meteorological forecasts and warnings, etc.

Central Office.—All observations made at kite and balloon stations by the Army and Navy, as well as by the Weather Bureau, are forwarded to the central office of the Weather Bureau for final reduction and study. Data based upon these observations are furnished in answer to numerous inquiries, not only from other Gov-

ernment departments but from commercial aviation concerns as well. In many cases reprints of special discussions and summaries were issued in answer to these requests.

Work has been continued on the preparation of a summary entitled "An Aerological Survey of the United States." When completed, this will contain the results of all free-air observations made in this country.

The publication of monthly summaries of free-air conditions in current issues of the Monthly Weather Review was begun in January, 1922, and has been continued.

During the year there was brought to completion an exhaustive study of the relations existing between surface winds and temperatures on the one hand, and free-air pressures on the other, the purpose being to make possible the construction of pressure maps for upper levels for use in forecasting. This has been published as Supplement No. 21, entitled "The Preparation and Significance of Free-Air Pressure Maps for the Central and Eastern United States." A preliminary application has yielded encouraging results, and it is believed that with further extension of the study important and valuable aids to forecasters will be provided.

## CLIMATOLOGICAL DIVISION.

### METEOROLOGICAL REPORTS.

The work of checking receipt of and the examination of meteorological forms from all classes of stations, the preparation of letters correcting errors discovered in these reports, their filing, and final assemblage and binding for preservation have gone forward promptly, and the several processes of accomplishing these are as near up to date as feasible.

### PUBLICATIONS.

The Annual Report of the Chief of Bureau, 1921–22, was prepared and printed as usual, and special effort was made to make the chapters on windstorms, hail, etc., as complete as possible.

The summaries of climatological data from the various States were published without material change from the style last adopted. A useful feature of the climatological data for the California section was provided for in the form of an annual summary showing by months and for the season the precipitation for that section during the rainfall season 1921–22—that is, from July 1 to June 30—instead of for the calendar year. This summary is issued as promptly as possible after July 1, and gives to those interested in the seasonal distribution of precipitation in that State the earliest possible facts. The publication has been well received by the water interests of the State and may be extended, if found desirable, into other Pacific States where precipitation conditions are similar to those of California.

A special effort was made at the close of 1922 to have printed for each of the regular stations an annual summary of station weather data for that year, together with tables of monthly and annual means of temperature and monthly and annual totals of precipitation, for the entire period of observations at the respective stations, as these data, particularly those of the monthly and annual temperatures,

heretofore had not appeared in convenient form for distribution and study. This work was accomplished largely by the hearty cooperation of the office forces at the various stations provided with printing facilities, and much credit is due station officials for the spirit of cooperation exhibited, particular attention being invited to the Fort Worth, Tex., office, where more than 20 such reports were printed. These reports serve many needs at the stations and are greatly in demand for answering questions concerning local weather conditions.

### COOPERATIVE WORK.

The gathering of weather data by our large army of cooperative observers progressed as usual, though no great effort was made to extend this work, save in a few localities where the absence of a permanent population interferes with the collection of continuous data.

As indicating the increasing demands for weather information in connection with business interests, attention is invited to the numerous requests for the opening of new observing stations and the willingness of individuals, companies, and other organizations to furnish, without cost to the Government, the necessary outfit of instruments, provided the bureau will advise as to the selection of the necessary apparatus, supervise its exposure, and have general control of the observations in order to assure the collection of reliable data. The country is mainly so well covered with reporting stations that no material extensions are required, and such new stations as are being opened, particularly those recording temperature, are mainly at the expense of those requiring the service.

Cordial cooperation continues with many departments and bureaus of the Government in securing observations from localities which otherwise would be unrepresented on account of scarcity of population. This is particularly the case with the Forest and Indian Services, whose employees cover areas having no stable population.

### INSPECTION OF COOPERATIVE STATIONS.

On account of lack of sufficient funds for several years, the inspection of cooperative stations has been badly handicapped, and a crying need for wholesale inspections is now apparent. As stated in previous reports, such inspections are necessary to establish that personal connection between the bureau and the cooperative observer which seems so necessary to permanent cooperation. In fact, the lack of this contact is believed to be the weakest point now existing in our system of cooperation in collecting weather data.

### WEATHER INSURANCE.

The demands of the public for protection on account of changes in the weather, in every conceivable manner, have necessitated on the part of insuring companies the collection and careful study of precipitation statistics, and many calls have been made on this division, as well as the various stations, for data on the distribution of precipitation during the various parts of the day and otherwise, in order to arrive at rates reasonable to those seeking protection and safe to the insuring companies. The general matter of rain insurance has necessarily entered into the field of our cooperative

observers, who receive many requests for statements concerning the precipitation for certain specified periods. These requests will doubtless greatly increase as this form of protection grows, and it promises serious complications in the way of payment for service, possible errors of record due to attempts to secure data for other than the regular hours of observation, etc.

### SPECIAL WORK ACCOMPLISHED DURING THE YEAR.

The preparation of the daily normals of maximum, minimum, and mean temperatures was continued during the year, the reduction of the short-record stations to the full 46-year period being a task of great magnitude, and only slow progress has been possible owing to press of current work.

The reprinting of the sections of Bulletin W, which had made good progress during the preceding year, made little advance during the fiscal year just closed, on account of lack of funds. The printing of 25 additional of these sections was authorized near the close of the year, but they still remain unprinted.

The program outlined some years ago for collecting, tabulating, and printing of weather statistics from foreign countries was taken up during the fiscal year just closed by the assignment to the division of an assistant versed in such matters. Considerable progress has been made in assembling the data for the Central and South American States, and one section, that on Central American States and adjacent areas, has been published in the Weather Review and separates obtained for distribution as required. Other sections for the principal South American countries are mainly ready for publication, but are being held for additional data that may be forthcoming from other sources than our library affords.

A proposed section covering the islands of the Pacific is also well on the road to completion.

## THE MONTHLY WEATHER REVIEW AND PRINTING.

The Monthly Weather Review, now in its fifty-first year of publication, continues to serve as an important medium in the diffusion of information concerning the results of research in meteorology in all parts of the civilized world. It also enables the United States to meet its international obligations to furnish other nations and Governments with a statistical résumé of the meteorology and climatology of an important part of the North American Continent.

The number of copies of the above-named publication that shall be printed for free distribution has been limited. As the demand for it increases it becomes embarrassing to distinguish between those who should receive it gratis and those who should be required to subscribe for it through the Superintendent of Documents. The experience of the bureau leads to the belief that the time is fast approaching when free distribution to individuals as such must be restricted to those who can qualify under certain broad requirements, such, for example, as being a collaborator or cooperator with the bureau, an educational institution offering a course in meteorology, libraries, and workers in agricultural colleges and experiment stations.

On account of the special courses being given by educational institutions throughout the country in meteorology and kindred sub-

jects, the demand for all publications has increased considerably. It has been the policy to comply with these requests in such numbers as the existing regulations will permit. Applications for publications from individuals receive prompt and careful attention. In case the publications are exhausted or can not be supplied the applicant is so advised.

During the year several new publications were printed, including a chart of Description of Cloud Forms and two Monthly Weather Review Supplements, entitled "The Spring Floods of 1922" and "Thermal Belts and Fruit Growing in North Carolina." These supplements contain valuable meteorological data for which there has been a considerable number of requests from institutions, engineers, and specialists in this particular work.

Paid subscriptions for the daily weather map have increased. Insurance companies, specializing in rain insurance, have found the daily weather map and climatological statistics an important factor in their work. The increase in subscriptions for the Monthly Weather Review through the Superintendent of Documents has made it necessary to furnish additional copies to meet the public demand. The present subscription price of the Monthly Weather Review is $1.50 per year, payable in advance to the Superintendent of Documents, Government Printing Office, Washington, D. C. The Monthly Weather Review Supplements are available for purchase through that office at a price furnished upon application, provided the edition is not exhausted. They are not included in the subscription for the Monthly Weather Review. The mailing lists of the Weather Bureau have been revised and brought up to date, resulting in the discontinuance of a number of subscriptions.

Under the regulations prescribed by the congressional Joint Committee on Printing, quarterly printing-plant reports and annual inventory reports from 97 field stations and the printing office, Washington, D. C., were rendered to the chief, Division of Publications, Department of Agriculture, for transmittal to the committee. The data furnished on each of these quarterly reports include number of jobs, total number of copies, number of type pages per copy, number of illustrations, total cost of printing and binding, editorial cost, and the proportionate salary for the quarter, and number of employees engaged on the work. Samples of all work performed during the quarter are attached to these reports. The inventory report rendered annually includes the printing and material and equipment on each of the field stations and the printing office, Washington, D. C., with the cost of each item of machinery or equipment, and the estimated value at the present time. These reports also show whether the plant is housed in a Government-owned building or rented property. Contract-printing and printing-machinery reports are also rendered quarterly.

## INVESTIGATIONS IN SEISMOLOGY AND VOLCANOLOGY.

The important work of collecting and publishing earthquake data, begun December 1, 1914, has been continued during the year.

Instrumental records have been obtained by instruments owned and operated by the Weather Bureau at Washington, D. C.; North-

field, Vt.; and Chicago, Ill. Similar data have been secured for publication from various seismic observatories distributed from Panama to Canada and from the Hawaiian Islands to Porto Rico.

The noninstrumental reports rendered by the regular and cooperative observers of the Weather Bureau recorded 84 separate earthquakes strong enough to be felt by the unaided senses in continental United States during the calendar year 1922. Although some of these were felt over wide areas, none resulted in appreciable damage. No important earthquakes occurred in our outlying possessions.

Special investigations and observations of volcanic phenomena have been steadily conducted at Kilauea. In the main, activities at this place have been mild, and at the time of this report the volcano is practically dormant.

## LIBRARY.

During the fiscal year 968 books and pamphlets were added to the library, bringing the total strength of the collection up to about 42,000 volumes.

In addition to these books, which are kept at the central office in Washington, though available for loan to stations, there have been issued to stations for permanent use during the past 25 years more than 11,000 books, generically described as "station textbooks." Allowing for books withdrawn, discarded, lost, etc., the number of such books now permanently deposited at Weather Bureau stations is estimated at more than 8,000, not including files of Weather Bureau publications and various miscellaneous books of which no record is kept at the central office. An especially strong collection of meteorological literature has been assembled at the Chicago station. This collection contains many rare works, including files of the leading meteorological journals and foreign official reports, and has been gathered to serve as a reserve library, from which books could be transferred to the main library in Washington in case of loss of the latter by fire. Station libraries are used to some extent by the public as well as by the personnel of the stations. Inquiries for meteorological information addressed to the central office are in many cases answered by referring the inquirers to books accessible at Weather Bureau stations.

## OCEAN METEOROLOGY.

This work is sustained by the cordial cooperation of many shipmasters making daily observations at Greenwich noon. The number of reports rendered was adequately maintained, in so far as the regions traversed by the principal trade routes were concerned, and the matter furnished for periodical publication on the Pilot Charts and elsewhere was prepared in the usual manner, and the Hydrographic Office was assisted in the revision of texts relating to cyclonic storms for its publications.

An important feature of work accomplished during the year was the preparation of a comprehensive article on the tropical storms of the eastern North Pacific Ocean, off the west coast of Mexico and Central America. This work was undertaken in the interest of the

shipping in those waters, which has greatly increased in volume since the opening of the Panama Canal.

Requests have recently been renewed for the Weather Bureau to increase its contributions of data relating to world meteorology. Further participation in this work, however, must await increase of force.

## INSTRUMENT DIVISION.

THE INSTRUMENT INDUSTRY.—Conditions during and immediately following the war which made it difficult to obtain instruments from Europe have been followed by the stimulating effect created by demands from the Army, Navy, Air Service, and Shipping Board, and from industrial concerns, for meteorological instruments. American manufacturers have hence been justified in undertaking the manufacture of instruments heretofore largely imported, so that practically all the instruments used by the Weather Bureau are now obtainable in this country. However, clocks for the recording cylinders of thermographs and barographs await further development, and there is considerable promise along these lines also. The present tariff schedule requires the various branches of the Government to pay from their appropriations the same import duties as are paid by anyone else; hence there is no financial advantage to a bureau in purchasing instruments abroad, and such conditions are favorable to the upbuilding of a stable and dependable meteorological instrument industry in this country.

The storm-warning display equipment, which was thoroughly overhauled several years ago, has required little repair, except on the Gulf coast, where changes in organization and the rapid deterioration of ironwork have required a considerable number of replacements. The three-lantern system of display, now in satisfactory operation throughout the bureau, has not been found unduly expensive to maintain.

Exposures of instruments at a number of first-order stations are becoming impaired by the rapidly increasing erection of high office buildings. The problem is not solved by moving the instruments to the higher building. While the wind instruments are given a better exposure by such a removal, the rain-gauge exposure is seriously impaired. Meteorological stations in parks or suburban observatories offer the best solution of the problem of securing sound meteorological data in the large cities.

The evaporation program inaugurated in 1916 has been continued, with about 50 stations rendering regular reports, which are published in the State section reports. Many requests for additional stations have had to be refused because funds were not available for extensions. The data being accumulated are of much value, particularly at this time of increased interest in water resources. A careful digest of accumulated evaporation records is much needed.

Measurements of rainfall for short periods at places where outdoor events are insured against rainfall are in increasing demand. The conditions set forth in insurance policies require exactness, particularly as to time, while the large amounts sometimes named in the policies justify unusual precautions against unauthorized interference. Three of the weighing-recording gauges described in Circular

E, Instrument Division, have been issued for this purpose, and, in an effort to secure a less expensive gauge that would assist observers, an 8-inch gauge has been fitted with an attachment that automatically shifts the flow to the measuring tube at the beginning of the insurance period and out of the tube at the end of the period.

The investigations in anemometry by Messrs. Fergusson and Covert, begun in 1922, are nearly completed. Final corrections for the present standard and many other patterns have been determined throughout the range of the natural wind for the first time in the history of anemometry, and from a group of instruments of an improved pattern it is expected that there will be selected a new standard whose indications will be more nearly constant than those of the present standard. This work has been made possible by the kind cooperation of the Bureau of Standards.

The advice of the Weather Bureau is being sought with increasing frequency regarding ways and means for protection against lightning, which inquiries are largely due to the extensive circulation of Farmers' Bulletin No. 842, "Modern Methods of Protection Against Lightning."

During the past year and a half Roy N. Covert has represented the Weather Bureau on a sectional committee of the American Engineering Standards Committee, which is developing a standard for the protection of buildings and other property against lightning. The American Institute of Electrical Engineers and Bureau of Standards are acting as sponsors for this standard, which should be available for public use during 1924. As stated in the introduction to the standard, its purpose is to promote the prevention of fire and other loss from lightning by directing attention to the best available means of protection. Practically all organizations interested in protection against lightning are represented on the sectional committee.

The exhibit work of the Weather Bureau is now merged with the general exhibit work of the department, exhibits being made largely by subjects rather than by bureaus. Under the present plan a committee is created for each major exhibit, with a representative from each bureau of the department, to bring before the general committee the facts that his bureau can contribute. The chief of the Instrument Division is the Weather Bureau representative on committees now preparing the 1923–24 exhibits.

## SOLAR RADIATION INVESTIGATIONS.

As in past years, the intensity of solar radiation at normal incidence has been measured on days when the sky was free from clouds at Washington, D. C.; Madison, Wis.; and Lincoln, Nebr. The total radiation received on a horizontal surface directly from the sun and diffusely from the sky has also been continuously recorded by automatic instruments. The results have been published each month in the Monthly Weather Review.

A thermoelectric pyrheliometer has been devised and constructed in the Weather Bureau machine shop for use in connection with a recording voltmeter to obtain continuous records, not only of the total radiation received on a horizontal surface but also of the in-

tensity of solar radiation at normal incidence. Pyrheliometers of this type are now in use at Washington; one has been furnished to the Chemical Warfare Service for experimental work at its arsenal, Edgewood, Md., and two others are about ready to be installed at the Weather Bureau observatories at the University of Chicago, Chicago, Ill., and in Central Park, New York. A description of this pyrheliometer has been published in the Monthly Weather Review for May, 1923, and in the Journal of the Optical Society of America, and Review of Scientific Instruments for September, 1923.

A convenient method has been devised for the determination of the intensity of daylight that may be expected at window openings in the country, on city streets, or on open or closed courts. Briefly stated, the method utilizes the measurements of sky brightness and daylight illumination made by the Weather Bureau in recent years and determinations by the Weather Bureau and others of the coefficient of diffuse reflection of different materials to determine the brightness of the various surfaces that are visible from a window, such as sky surface, lawn or street surface, the walls of buildings, etc. A complete demonstration of this method has been prepared for publication in an early number of the Journal of the Illuminating Engineering Society.

The Weather Bureau received 1 of the 12 Owens dust counters which were distributed to observatories in 12 different countries by the Bureau of Section (C), Meteorology, of the International Union of Geodesy and Geophysics and is taking part in an international investigation of the dust content of the atmosphere. Since December 7, 1922, a determination of the number of dust particles per cubic centimeter has been made on each working day and the character of the particles noted. Most of the determinations have been made in a suburb of Washington, but on some days measurements have also been made on the street near the center of the city and also at the top of the Washington Monument, 500 feet above the street level. Through the cooperation of the Army Air Service a few examinations of atmospheric dust have been made during airplane flights up to a height of 12,000 feet above sea level, and arrangements have been made for more observations of this character. For this purpose a modification of the Owens dust counter has been designed and constructed in the Weather Bureau machine shop.

Besides city smoke and particles taken up from the surface of the earth by the wind, occasionally particles are found that appear to be of volcanic origin or even from some source other than the earth.

The investigation has special reference to atmospheric pollution in cities, and also to atmospheric transparency, which is of prime importance to aviators.

In cooperation with the Chemical Warfare Service experiments were conducted at the Edgewood Arsenal, Md., to determine the efficiency of a smoke barrage, such as is employed by the Army to cover the movements of troops, in protecting orchards and other forms of vegetation from damage by frost. The results, which have been prepared for publication, confirm our previous conclusions that the most practical and economical method of combating frost is to heat the surface layer of air by the combustion of some form of cheap fuel.

# REPORT OF CHIEF OF BUREAU OF AGRICULTURAL ECONOMICS.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF AGRICULTURAL ECONOMICS,
*Washington, D. C., October 12, 1923.*

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Agricultural Economics for the fiscal year ended June 30, 1923.

Respectfully,

HENRY C. TAYLOR,
*Chief of Bureau.*

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Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

The first year's accomplishments of the Bureau of Agricultural Economics, a consolidation of three separate bureaus that formerly handled economic subjects, presents conclusive evidence of the increased effectiveness which has resulted from this combination. The benefits have been threefold: The development of new forms of helpful information for agriculture in the present period of readjustment; the expansion of fundamental studies in farm organization, marketing, and crop estimating; and an increased efficiency of the entire personnel through closer cooperation, broadened knowledge, and the stimulation of an enlarged organization.

## NEW SERVICES TO THE FARM INDUSTRY.

In the period of agricultural readjustment experienced during the past year it was important for farmers to secure the facts bearing upon current problems that would give them the greatest aid in making the right decisions in planning farm operations and in marketing their products. The first attention of the bureau staff has been directed constantly toward these problems in response to the greatly increased demands upon the bureau for information on the general conditions of supply and demand, price trends, the effect of various factors, domestic and foreign, upon the farmer's returns, and for information bearing upon problems of crop readjustment.

In gathering facts bearing upon these questions, the closer relationship of workers in farm management, marketing, and crop estimating has been especially helpful. By bringing the field services of these three lines into closer contact, the interchange of important information has been facilitated, and research, service work, and extension teaching has been made more effective. The bureau is now in a position to present a complete picture of the economics of agriculture from the problems of the individual farm through the problems of distribution and marketing to the more general considerations of world supply, consumer demand, and foreign competition.

In periods of low and unsatisfactory prices the call for facts concerning prospective supply and demand becomes more insistent. The forecasting of crop and livestock production forms the basis of our knowledge of the future market for farm products. One of the main purposes of the new bureau during the past year has been to strengthen present reporting methods and to supplement them by special types of surveys designed to give a more accurate knowledge of future supplies. Such supplemental surveys were those of intentions of farmers regarding the breeding of hogs and the planting of various crops.

The pig survey, which was first made in June of the last fiscal year, was repeated in December, 1922, and again in July, 1923. These surveys gave an indication of intentions of farmers regarding the production of hogs, and the distribution of the summary of these intentions gave farmers a basis upon which to adjust their plans in accordance with the indicated supply.

#### FORECASTS AID IN READJUSTMENT.

Intentions of farmers regarding the planting of various crops were gathered in a survey early in the spring and again in midseason. The distribution of this information concerning preliminary plans of farmers has enabled them to adjust acreage, and, to some extent, to prevent over or under planting of particular crops. These first efforts in this direction have been more or less experimental and future surveys will be improved as our experience grows.

Every farmer must plan in advance and forecast for himself what he expects the future market to be. The two principal benefits to be derived from agricultural forecasting are: First, it will assist the individual farmer in wise planning in production and marketing; second, from a national standpoint, it will tend to promote the right utilization of land and to avoid the losses to producers from excess production and the unusually high prices to consumers which accompany a shortage of production.

The accuracy of the acreage and production estimates for crops, as it has been increased by the adoption of various ideas, aids the ordinary method of observation. Experiments with various measuring systems by the use of automobiles and air photography are under way. In livestock reporting a new step has been made by beginning the estimating of actual supplies for market of cattle and sheep. Estimates of the number of these animals on feed in the Corn Belt and in western States have been made at intervals, accompanied by weekly reports of the movement of lambs and feeder cattle to market from the range. Through cooperation with railroads and other shipping agencies, an accurate measure of the movement of these animals is being attempted.

The influence of world supply and demand upon prices received by American farmers is being more closely studied, and through the development of a world-wide crop and market reporting service the facts concerning probable foreign competition and demand are being made available. This has been accomplished through our agricultural commissioners in England and Europe, through our other representatives in foreign countries, through the International Institute of Agriculture at Rome, and through an improved news service by cable and radio.

### OUTLOOK REPORTS INTERPRET THE FACTS.

In order that the relative significance of all of these factors be properly interpreted, the plan of holding a conference of a group of well-known economists and statisticians to examine the facts and prepare a statement on the agricultural outlook was inaugurated in April under the direction of the Secretary of Agriculture. This group considered the entire situation. It then prepared and issued a summary of the data gathered by the bureau and set forth the probable trend of the next few months as indicated by the available data. This conference was designed to interpret the situation for producers and others in brief and specific statements such as those who are untrained in the handling of a large mass of material find it difficult to make. Every resource of the bureau has been drawn upon to make these forecasts as accurate as possible, and to put them in a form that will be of the greatest use to the farming industry in the present period of readjustment.

Special attention has been directed during the year to a study of factors influencing market demand in domestic markets, not only as expressed in the prices and movement of crops but also in consumers' requirements. Special studies of cities and surrounding communities to discover sources of their supplies and possible extension of local production have been begun at several points. Analysis of the supplies flowing into large consumption centers such as New York and Boston have been made with a view to discovering the normal needs of these communities and factors which cause a variation in consumption. Studies of influence upon consumer, demand of methods of marketing, systems of retail distribution, and publicity have been inaugurated to provide a basis for determining the consideration which influence per capita consumption of certain products.

Results of the several years of farm management surveys have been reviewed to secure facts of value in the present readjustment, and the objective has been shifted somewhat from studies with the historical point of view to the current readjustment point of view to aid in meeting the present and forthcoming changes.

During the year there has been a steady growth in the work in warehousing, improved farm finance, and in the study of agricultural cooperation. All of these are factors entering into the improvement of the marketing organization of agriculture, upon which we must first assemble a broad knowledge of conditions and experience before venturing forward in new methods. By utilizing improved means of disseminating this information by telegraph and radio, the bureau has quickened its services and broadened the field of distribution.

### RESEARCH COUNCILS ESTABLISHED.

A forward step to the end of correlating various research projects conducted by State and Federal institutions was begun during the year by establishing the New England Research Council on Marketing and Food Supply.

All institutions within the region doing research work on agriculture are represented in this organization. The representatives keep in close touch through a secretary and meet at intervals to compare and correlate projects. Experience has shown that this leads to better division of labor, better results in research work, effects econ-

omies, and develops a broadened viewpoint on the part of all concerned regarding the projects in hand. A similar council has been planned for the Middle West and has been organized since the end of the fiscal year. It is important in the economic field that there be the minimum duplication of effort if all of the important problems are to be covered by the funds available.

## EXPANSION OF MARKETING WORK.

The market activities begun in the former Bureau of Markets have been extended along four major lines: Research, standardization, market news, and inspection. During the year market grades have been prepared and distributed either in tentative or finished form for the following products: Hay, wool, tobacco, rice, rye, peanuts, dressed meats, and for certain fruits and vegetables. The research work necessary to the preparation of these standardized grades is being continued in order to perfect them in keeping with market requirements, in justice to both producer and consumer. The market news service on these and other products has likewise been extended, the principal expansion taking place at the end of the fiscal year, when an increase of about $300,000 in the appropriation by Congress for market news work became available. In preparation for this expansion considerable work was done during the fiscal year under review.

The shipping point inspection service, which brings close to the producer the practical benefits of standard grades, has received particular attention. This work has proved not only of tremendous educational value in training the producer in the requirements of the market, but it has also placed within his reach a Government certificate stating the quality and character of his product, which gives him a new basis for trading with the assurance that disputes concerning the quality of the goods will be minimized and that their character can be established in case of loss in damage in transit. This has led to a new system of marketing which promises to transfer the sale of a larger volume of produce from the terminal market to the primary market and facilitate the distribution of products to various markets with the minimum of gluts or shortages. At the same time the terminal market inspection has not been curtailed but has been strengthened along the regular lines previously followed.

The establishment of universal standards for American cotton through agreement with the European cotton exchanges followed the passage of the United States cotton standards act. The official cotton standards of the United States were adopted with but minor changes. This is further and convincing evidence of the integrity of our standards. The immediate negotiations to this end were begun in the fiscal year under review but were completed at conferences later in the summer. The way has been opened to the establishment of other world-wide standards which may be expected to lead to improved international trade in American farm products.

## NEW WORK IN FARM MANAGEMENT.

The creation of the larger bureau has resulted in the extension of specific work in farm management through closer cooperation with all workers in this field with those in marketing and crop esti-

mating. The fundamental lines of research followed for a number of years have been continued and strengthened and many new types of studies have been introduced.

Farm management studies have been expanded to include studies of farm income on various types of farms, farm production in localities adjacent to cities, the organization of cane sugar farms; a special survey of cotton farms in boll weevil districts, studies of the earlier farm management records to develop facts of value in the present period of readjustment, studies of how to measure farm labor efficiency, investigations of the use value of land, and surveys of regions on which studies have been made in previous years to discover important changes in management.

Cost of production work has been continued and expanded along lines which have been followed for a number of years and with a wide variety of crops, including wheat, cotton, tobacco, fruits, sugar beets, and sugar cane. The projects in studies of fattening cattle have been expanded as have been field cost surveys on ranches. These activities have been conducted without in any way restricting the projects previously mentioned, but rather as an aid to them in that the results from the many separate projects previously conducted have been brought together in a manner to be of particular value to the farmer in making readjustments in his business.

The distribution of the field studies has been planned to provide a constantly increasing number of farmers with specific information in terms closely approximating those with which they are familiar, upon which they may base readjustments of their own activities as conditions change, in the light of results achieved by farmers in situations similar to their own. The number of direct contacts with farmers is large. Through example, extension work, and incidental publicity the influence of this work is widespread, though at a given time exact evaluation of its effect may not be possible.

The crop and livestock estimating work has been carefully gone over with a view to making the forecasts of the greatest value to producers in determining future plans. Every effort has been made to preserve the accumulated value of early statistics while adopting the newer methods of forecasting.

## THE NEW BUREAU ORGANIZATION.

The first step toward bringing the three related bureaus together was made in July, 1921, when the Bureau of Markets and the Bureau of Crop Estimates were consolidated. While this combination provided for establishing a central administrative control, the proper interrelation of divisions required gradual changes in order to secure a more effective organization. On July 1, 1922, the beginning of the year covered by this report, the Office of Farm Management and Farm Economics was combined with the two bureaus previously united, and the name was changed to that of the Bureau of Agricultural Economics.

In the new consolidated bureau the identity and the organization of the various lines of work formerly handled in the three bureaus has been preserved in the associated divisions under three groups: (1) The production divisions, including farm management, cost of production, and crop and livestock estimates; (2) the commodity marketing divisions, or those having to do with cotton, grains, fruits and vegetables, livestock, meats and wool, hay, feed and seeds, dairy

and poultry products, warehousing, and city markets; (3) the group of general divisions dealing with problems concerning both production and marketing, cost of marketing, statistical and historical research, including foreign competition and demand, agricultural finance, land economics, agricultural cooperation, and farm population and rural life and a division which handles publication and news distribution problems.

The divisions of the bureau and principal sections under each division are shown in the accompanying outline.

## ORGANIZATION OF THE BUREAU OF AGRICULTURAL ECONOMICS.

### ADMINISTRATION.

HENRY C. TAYLOR, *Chief.*
LLOYD S. TENNY, *Assistant Chief.*
WM. A. SCHOENFELD, *Assistant Chief.*
J. CLYDE MARQUIS, *Director of Economic Information.*

### PRODUCTION DIVISIONS.

*Farm Management.*—H. R. TOLLEY.
Farm Practices and Types of farms.
Organization of Southern Farms.
Farm Business Analysis.
Farm Incomes.
Farm Power.

*Cost of Production.*—R. H. WILCOX.
Farm Records and Accounts.
Livestock Costs.
Crop Costs.
Cost and Price Relations.

*Crop and Livestock Estimates.*—W. F. CALLANDER.
Crop Reporting Board.
Field Service.
Tabulating and Computing.
Research in Statistical Methods.

### MARKETING DIVISIONS.

*Cotton.*—W. R. MEADOWS.
Classification of Cotton.
Preparation and Distribution of Official Cotton Standards.
Future and Spot Market Investigations.
Cotton Testing.
Investigation of Cotton Standards.
Cotton Marketing Demonstrations.
Research in Cotton Marketing.
Cotton Handling Investigations.

*Fruits and Vegetables.*—W. A. SHERMAN.
Market News Service.
Inspection Service.
Grades and Standards.
Standard Containers
Research in Marketing.

*Warehousing.*—H. S. YOHE.
Grain Warehousing.
Wool Warehousing.
Tobacco Warehousing and Standardization.
Cotton Warehousing.

*Livestock, Meats and Wool.*—C. V. WHALIN.
Market News Service.
Meat Investigations and Standardization.
Livestock Investigations and Standardization.
Wool Marketing and Standardization.

*Hay, Feed, and Seed.*—W. A. WHEELER.
Hay and Feed Marketing.
Investigations and Market News Service.
Seed Marketing Investigations and News Service.
Hay Standardization.
Hay Inspection Service.
Broomcorn Market Investigations and News Service.

*City Markets.—Washington Center Market.*—C. W. KITCHEN.
Administration.
Mechanical Section.
Cold Storage.
Inspection.

*Grain.*—H. J. BESLEY.
Grain Investigations.
Milling and Baking Investigations.
Research Laboratory.
Establishment of Grades for Barley and Rye.
Grain Cleaning.
Bulk Handling.
Federal Grain Supervision.

*Dairy and Poultry Products.*—ROY C. POTTS.
Dairy Products Investigations.
Poultry Products Investigations.
Market News Service.
Dairy Inspection Service.

*Cost of Marketing.*—A. V. SWARTHOUT.
Cost of Marketing Livestock.
Cost of Marketing Grains.
Cost of Marketing Fruits and Vegetables.
Cost of Marketing Cotton.
Retailing Meats.
Market Business Practices.

GENERAL DIVISIONS.

*Agricultural Finance.*—V. N. VALGREN.
Rural Private Finance.
Rural Public Finance.
Agricultural Insurance.
Rural Public Utilities.

*Statistical and Historical Research.*—O. C. STINE.
Foreign Competition and Demand.
Production Statistics.
Market Statistics.
Agricultural History.
Transportation.
Graphics.

*Agricultural Cooperation.*—L. S. TENNY.
Economics of Cooperation.
Statistics of Cooperation.
Legal Phases of Cooperation.

*Farm Population and Rural Life.*—C. J. GALPIN.
Rural Population Statistics.
Population Aspects of Rural Community Buildings.
Farmers Standard of Living.

*Land Economics.*—L. C. GRAY.
Land Resources and Utilization.
Land Reclamation Sale and Settlement.
Farm Labor.
Land Tenure.
Land Values.
Negroes and the Land.

*Division of Information.*—J. C. MARQUIS.
Editorial.
Periodicals and Press Service.
Radio News Service.
Exhibits and Motion Pictures.
Market News Research.

This organization now comprises a Washington office with 990 employees and a field organization including some 148 branch offices of various types in 79 cities including 936 workers. The work of this organization is assembled around the main artery of communication, the leased wire system, which at the end of the fiscal year included 3,300 miles of leased wire extending from Boston in the East, to Minneapolis in the Northwest, and Austin, Tex., in the Southwest. On July 1 this system was extended to include Denver, Salt Lake City, Sacramento, San Francisco, Los Angeles, and Portland in the West, and later to Atlanta in the South.

Together with the movable field forces which include individual investigators, field statisticians, and special survey parties, the bureau now has contacts through its own staff with every important agricultural industry. Through the consolidation into a single bureau, the facilities of the leased wire, formerly utilized for market news only, have been made available for the dissemination of crop and livestock estimate information. Supplementing the leased wire, the system of radio broadcasting, primary and secondary, provides communication with all important agricultural sections of the country. The utilization of this organization is shown in detail in the descriptions of divisional activities which follow.

## DIVISION OF FARM MANAGEMENT.

H. R. TOLLEY, *In Charge.* O. A. JUVE, *Cost Accountant.*

Farm Practice, and Types of Farming, W. J. Spillman; Organization of Southern Farms, C. L. Goodrich; Farm Business Analysis, H. W. Hawthorne; Farm Incomes, S. W. Mendum; Farm Power, L. A. Reynoldson and J. W. Tapp.

The Division of Farm Management has studied farm problems with the individual farmer constantly in mind. Its staff is composed of men of broad experience in farm operation. Its field contacts are with individual farmers, whose experience under observed conditions is recorded and analyzed for the purpose of supplying to farmers the most serviceable methods and ideas gleaned from

every available source as well as from their own group experience. Other divisions of the bureau make frequent demands upon the staff for data relating to individual farms or groups of farms, so that no small part of its service rendered lies in its contributions to the more general economic problems directly in the hands of other divisions. Much of its work is done in cooperation with state research organizations, as well as with other divisions of the bureau and of the Department of Agriculture. The problems of farmers are complex, because of changing conditions, so that studies covering extended periods of years are carried on and new ones are undertaken as those in process are completed.

The analysis and presentation of the data which have been collected during the past three years on the cost-accounting routes conducted by the Cost of Production Division was begun. The plan is to make this material available in such form that it can be used by the farmers who contribute the material, and by other farmers similarly situated, in choosing the best enterprises to include in their farm business, and in keeping these enterprises properly adjusted to changing conditions. This work is done in cooperation with the Cost of Production Division.

A comprehensive study of land utilization and farm organization in the northern Great Plains region was inaugurated, with a view to determining as nearly as possible from the experience of those who are farming there just what types of farming are best suited to the different parts of the region. The Division of Land Economics cooperates in this study.

#### DISTRIBUTION OF TYPES OF FARMING SHOWN.

A series of maps showing the geographic location of different types of farming throughout the country has been prepared. These maps will afford a better basis than has heretofore been available for determining the areas to which the results of its investigations are applicable.

Incomes from farming in 1922, together with the relative importance of different sources of receipts and expenditures in different sections of the country were determined, and reports from over 6,000 farms summarized and published. Plans were made for continuing this project on a larger scale during the coming year.

The problems of agricultural production in areas adjacent to cities was the subject of study with a view of determining the extent to which adjustments in production to meet the local demand can profitably be made. The area adjacent to Altoona, Pa., was chosen as the location for the first study, and plans were laid for making similar studies near a number of other cities during the coming year. In this work the division cooperates with other divisions and institutions.

A study of the management and organization of sugar-cane plantations in Louisiana was arranged in cooperation with the Cost of Production Division and the Louisiana State College. Complete records of the activities of a number of plantations are being kept for the year which when completed will be studied to determine the most profitable methods of producing sugar cane.

A farm management survey of 450 farms in Chester County, Pa., was begun. A somewhat similar study was made in this same area in 1911. The present study was undertaken to determine the changes in the organization and management of farms in this area during the 12 years intervening between the two investigations and to find out as nearly as possible the types of farming which will be most profitable there under present conditions.

An investigation was begun, in cooperation with the South Carolina College of Agriculture and Agricultural Experiment Station, to determine the changes in the organization and management of farms in that State which need to be made to meet the conditions that have developed there since the advent of the boll weevil.

#### STUDIES IN IDAHO, OHIO, AND FLORIDA COMPLETED.

A three-year study of farming in the irrigated sections around Twin Falls, Idaho, carried on in cooperation with the University of Idaho, was completed.

A six-year study of the management of citrus-fruit farms in Polk County, Fla., and of the organization and management of truck farms in Hillsboro County, Fla., was completed.

A five-year study of the effect of tractors on the organization of farms in northern Ohio was completed.

#### PROGRESS MADE IN CONTINUATION PROJECTS.

Four projects begun in previous years were continued. For the eleventh consecutive year, farm business analysis records of about 60 farms in Washington County, Ohio, were secured; for the second year, a study of the organization of dairy farms in Vermont; also for the second year, a study of dairy farms in New York State; cooperation was continued with the State colleges of Arkansas, Georgia, and Mississippi on combined research and extension work.

A study of the organization of about 200 farms in the irrigated district of the Yakima Valley in Washington was begun.

#### INVESTIGATIONAL METHODS IMPROVED.

Considerable attention was paid during the year to methods of collection and analysis of material, with a view toward making the results of farm-management investigations more useful. New schedules were designed for use in most of the work begun and plans were made for using more refined statistical methods.

A special study was made, in cooperation with the Division of Land Economics, to arrive at the best method of determining the use value of land as compared with the sale value.

Another special study was made in an effort to find the best method of determining the relative value of different classes of labor used on the farm.

#### FARM MANAGEMENT DEMONSTRATION WORK ASSISTED.

In cooperation with the farm management demonstration work, of the States Relations Service, a series of lantern slides for an illustrated lecture on Why Analyze My Business was prepared; a scenario for a moving picture showing the advantages of proper

organization of the farm business was written, and plans were made for issuing a series of demonstration bulletins setting forth in a more direct and striking way than has been done heretofore the results of a number of farm-management investigations which have been made in the past year.

## DIVISION OF COST OF PRODUCTION.

R. H. Wilcox, *In charge.* O. A. Juve, *Cost Accountant.*

Farm Records and Accounts; Crop Costs, M. R. Cooper; Livestock Costs, G. S. Klemmedson and R. D. Jennings; Cost and Price Relations, C. R. Hawley.

This division is working with farmers to help them determine the most productive and profitable types of livestock and crops to produce, the most efficient methods in the management and production of crops and livestock, the cost of producing farm products, and the relation of cost to prices. Showing costs of different farm products is very important, especially just at this time when the farmer is confronted with making readjustments in his production and must have information on costs and relative profitableness of crops and kinds of livestock to aid him in adjusting these enterprises to assure the largest net return. The producer has been rendered valuable assistance through information assembled and sent broadcast by this division covering the most profitable methods and practices in production. Facts have been made available covering the influence of high standards of efficiency in crop and livestock production.

In the study of individual farm products considerable emphasis has been put upon analyzing the different cost factors to determine their relationship to each other and to the total cost. Particular attention is being given at this time to methods in the field and feed lot which will reduce to a minimum the necessity for direct cash expenditures and to substituting, in so far as economic, those enterprises that can be handled by the feed and labor available on the farm. This has led to studies covering the proportion of cash and noncash cost demands made by the important farm products during the course of their production, and has resulted in many adjustments being made by producers to reduce their cash expenses.

In all cost studies there has been determined the amounts of labor and equipment required for the various operations, the seasonal distribution of this labor, the quantities of feed and pasture used in the production of meat and horsepower, and with all farm products just how their demands upon the factors of production influence the organization of the farm of which they are a unit.

The work of this division is grouped into three sections: (1) Farm records and accounts, (2) livestock costs, and (3) crop costs.

### FARM RECORDS GATHERED IN MANY STATES.

Farm records and accounts are now being kept on a large number of farms covering the important systems and types of farming throughout the United States. These data depict for each type of farming a day by day record of farm operations, showing the demands made by each crop and kind of livestock for labor, machinery, cash expenditures, farm-grown feeds, and the other elements of production.

The scope of this work was expanded last year by beginning field studies in two heretofore untouched types of farming. Each farmer upon whose farm these data were gathered has been supplied with current reports covering his production and comparing his farm performance with the standards of his community. Information has from time to time been taken back to the communities in which studies are being made by the extension forces of the State colleges who through public meetings have given widespread assistance in helping each community solve its economic problem.

The results of six years' work in this field of investigation in New York State have been published in bulletin form. A second bulletin has been prepared by this division in cooperation with the State of Minnesota covering three years' results from a detailed cost route in Cottonwood and Jackson Counties, Minn. Two additional bulletins have been begun; one covering three years of work in Kansas and the second covering work in Montana.

All of the record and account work is carried on in cooperation with the State colleges and experiment stations, each State rendering financial assistance in the furtherance of this work.

#### WIDESPREAD STUDIES IN LIVESTOCK COSTS.

Livestock cost figures are now being gathered annually upon the many phases of cattle production and fattening from the ranches of the West, through the feed lots of the corn belt, and ending with the cattle finally at the stockyards ready for slaughter. In this phase of the cost work records are being gathered annually upon more than 100 ranches in Colorado and Texas. These production figures are supplemented with Corn Belt feeding costs each year covering more than 500 droves of western-grown cattle. A portion of the cattle are brought to the grass pastures of Kansas and there cost data are gathered on them until they are fat and shipped to market.

In this livestock work, as in other phases of the cost work, methods and practices are carefully analyzed with a view to determining for the livestock producer currently just the combinations of feed, labor, equipment, and other factors of production that will give him least cost and the largest net return. Data are assembled and given to livestock producers which indicate to them the condition under which livestock production is a profitable enterprise, the proper magnitude of the enterprise under different economic conditions, character of feed and equipment required, amount of labor involved, and the seasonal distribution of this labor, and show the relation of methods of feeding and herd management to efficiency in production. This livestock work is carried on with financial assistance from States in which costs are studied.

A special study has been made during the past year to determine the total cost to the cattle ranchman involved in running his cattle upon the forest reserves. Having these data to compare with costs upon summer grazing in fenced pastures, very considerable progress was made in helping each ranchman determine whether under his particular conditions it was more profitable for him to restrict his production to his own pastures or continue to use the forest reserves. General results obtained from this study have been published. In addition six reports have been issued covering work in livestock costs

in six Corn Belt States. Every farmer cooperating in these cattle studies has been furnished with reports covering the performance of his own cattle, together with data showing him good standards of performance in his community.

### COSTS OF HOGS IN 1922.

During 1922 this division has gathered cost figures on more than a quarter of a million pounds of pork produced in the important hog-growing States of the Mississippi Valley. This is the first work of its kind attempted in which not only cost figures were gathered but day by day breeding herd and feed lot practices and methods recorded together with the quantities of feed, pasture, labor, and equipment used upon each individual farm under different management. The results from these differing methods and practices in hog production have been published and give to the hog man just what influence size of litter, differing rations, per cent of death loss, kind of equipment, age of sows, and other factors have upon costs and profits in hog production.

The cost of dairy production in the important butter-producing areas of the United States were covered by this division in cooperation with the agricultural colleges and experiment stations in New York, Wisconsin, and Minnesota. Dairy cost studies were also made in California, New Jersey, and Ohio. In addition to studying the relative costs and profits under different feeding and management, special attention and study was given to relative costs and profits in producing milk of different grades. The demand for high-grade sanitary milk by the principal consuming centers has led to setting up certain sanitary standards with an accompanying guarantee in the form of a price bonus for milk reaching these standards. Study was made in New York to determine whether the price margin of high-grade milk was sufficient to cover the additional expense required to produce milk of high grade. Results of this study are being published in bulletin form.

### COSTS ON ALL IMPORTANT 1922 CROPS GATHERED THIS YEAR.

Crop cost figures for the entire United States covering 1922 production were assembled early this year. These figures gathered annually will furnish consumers and producers alike with information whereby they can measure the spreads between costs and prices and with which the economic condition of the crop-producing farmer can be measured currently.

Supplementing this widespread cost study, which shows conditions in agricultural production, local studies were made covering wheat production in sections of Oregon, Idaho, and Washington, and a former study into wheat costs in the principal spring and winter wheat sections of the country was summed up in a bulletin which is now in the hands of the printer. In the cotton cost work approximately 2,000 farm records covering a period of four years' work have been brought together, analyzed, and a publication prepared for distribution throughout the South giving to cotton growers a description of the field practices and methods resulting in the least cost and the highest net return in cotton production.

Investigators have been working with the tobacco growers of Kentucky and Virginia, the sugar-cane growers of Louisiana, the apple

growers of the Shenandoah Valley, the peach growers of New Jersey, the corn growers of Illinois, the wheat growers of Kansas, and the cotton growers of South Carolina, determining and pointing out the important causes for the present wide variation in costs, and showing, as a result of cost analysis, what combinations of the factors of production give the best results.

#### STATES LEND AID IN COST STUDIES.

Every State, in which cost work is carried on, is cooperating financially in so far as their State funds will permit. This indicates in a measure the importance placed upon these studies by institutions that are continuously looked to for sound advice. During the past year numerous requests have come from these State institutions that the cost work with their State be enlarged to cover types of farming not yet studied. The material gathered cooperatively by this division through farm records and accounts furnishes the background for university instruction in farm organization and management and in agricultural economics.

### DIVISION OF CROP AND LIVESTOCK ESTIMATES.

W. F. Callander, *in Charge.*

Crop Reporting Board, W. A. Schoenfeld, Assistant Chief of Bureau, Chairman; Research in Statistical Methods, J. A. Becker; Field Service, C. E. Gage; Tabulating and Computing Section, F. J. Blair.

#### INTENTIONS-TO-PLANT REPORTS BEGUN.

A new nation-wide inquiry was first made in April of this year covering all important crops to ascertain the acreage that farmers intended to plant to various crops, and from the thousands of reports received a statement was published which attracted a great deal of attention. In some quarters it was felt that the report was too late to permit farmers to change their plans with respect to crops of which the acreage gave indication of being too high or too low. This will be corrected another year. A second special inquiry was made as of August 1 to learn the intentions with respect to the planting of winter wheat and rye for the fall of 1923. This report was published August 15. It has been decided to incorporate intentions to plant reports into the regular system of crop reports, one to be issued in March covering spring-planted crops and one in August covering fall-sown crops.

#### A NEW SERVICE IN LIVESTOCK REPORTING.

With the material increase in the funds which was made available for the work of the division at the beginning of the last fiscal year, it has been possible to expand the scope of the work of the division so far as it relates to livestock. In developing plans to take care of the new livestock reports it was decided to handle the reports of swine direct from the Washington office, utilizing the rural carriers, and to depend entirely upon the field service for information concerning cattle and sheep.

### SPECIAL CATTLE AND SHEEP REPORTS.

Two conferences were held, one at Chicago and Denver, at which the general outlines of the new livestock estimating work in the Corn Belt States were decided upon, and one at Denver, where plans for the range States were drawn up. At these conferences representatives of livestock producers were present. The program decided upon covered not only largely increased information as to changes in livestock production but also information as to probable market supplies to be available at seasonal periods from various States and regions.

While there was available considerable general information as to livestock market supplies, little attempt had ever been made to determine the actual origins of these supplies, either as among different States or different regions of production, and none to localize sources of supply within States as shown by actual marketings. In order to obtain this basic historical information, it was necessary to go to sources that were largely new and compile records that had never been worked up before. This included the records of stockyard companies, packing establishments, railroads, sanitary boards, and other organizations that handle or have authority over the handling of livestock in its marketing processes.

The information secured covered three years, 1920, 1921, and 1922, and involved a vast amount of work in compiling and organizing. With some exceptions this work has been completed in the Corn Belt and Western States, and when it is all done complete information will be available for the first time as to the total marketings of livestock by species from these States, covering the monthly volume, the marketing channels, important contributing areas, the "in" movement of stocker and feeder animals, and the proportion of the total numbers marketed that are raised in each State and that are only finished there. Intelligently interpreted, this information offers a reasonably safe basis for making numerical estimates of probable market supplies. The reports issued during the year covering the Corn Belt and adjacent areas have included estimates of—

(1) Cattle on feed in the Corn Belt on December 1, 1922, as compared to the same date in 1921, with information as to the source and character of the cattle on feed and the indicated time of marketing; with which was combined an estimate of cattle on feed for market in the Western States.

(2) Sheep and lambs on feed December 1, 1922, as compared with the same date in 1921, covering both the Corn Belt and the western irrigated regions separately and combined.

(3) Cattle on feed January 1, 1923.

(4) Sheep and lambs on feed January 1, 1923.

(5) Early spring lamb crop on important areas, principally California, Kentucky, Tennessee, and Virginia, but including also Corn Belt areas as of March 1.

(6) Cattle on feed in the Corn Belt on April 1, 1923, as compared to April 1, 1922, with information as to the character of the cattle and the indicated dates of marketing.

(7) Report on the development and condition of the early lamb crop to April 1.

(8) Report on the condition of the early lamb crop on May 1 and the progress of marketing.

The reports for the 17 Western States made during the fiscal year included:

(1) Monthly estimates of condition of ranges, cattle, and sheep, expressed as percentages of normal condition. These reports, especially the range and

pasture condition figures, were used by stockmen as an index to prospective marketings and condition of livestock.

(2) Numbers of cattle expected to be sold from New Mexico and Arizona for spring delivery and from all Western States for fall delivery; also numbers of sheep expected to be sold for fall delivery from the chief western sheep States.

(3) Calf and lamb crops of the first half of the calendar year 1923, also losses of sheep and cattle for the same period. For some States also marketing and slaughter of cattle and sheep.

(4) Number of cattle and sheep on feed in December, 1922, and January, 1923.

(5) Weekly reports of numbers of fed lambs marketed from Colorado and California during March and April.

Movement of cattle from the Southwest into Kansas, Oklahoma, California, and Colorado, spring of 1923.

Special reports for individual States included: Cattle for market from the Flint Hills section of Kansas; goats and mohair in Texas; pasture condition in each county of California, monthly; percentage of fat cattle for market compared with previous year, for Oklahoma.

### SWINE REPORTS INDICATE PRODUCTION OF HOGS.

The special swine reports on the spring and fall production of pigs and intentions to breed which were started in the spring of 1922 in cooperation with the Post Office Department have proved a real success. In the spring of 1922, out of 500,000 schedules sent out to the rural carriers in the 17 States on which to gather information direct from the farmers, nearly 300,000 were returned. Based on the returns of these schedules a report was issued on June 25, 1922, which attracted a great deal of attention and which later developments showed to be approximately correct. Schedules were sent out and another report was issued in December similar to the one issued in June but covering the entire United States, and a third report was issued as of June 1, this year.

These reports have demonstrated their value as an indicator of the number of hogs that may be expected at market months in advance of the time when the report is made. The forecasts of intentions to breed are also of direct benefit to farmers and should become an important factor in stabilizing the supply. As the work develops and the weaknesses in the method are discovered and eliminated, it is believed that the actual number of pigs available for market can be forecasted many months in advance with a high degree of accuracy. The economic value of such information can not be questioned.

### MONTHLY LIVESTOCK CHANGES REPORTED.

Another line of investigation in connection with livestock reporting has been actively pushed during the past year, namely, the reporting of changes taking place from month to month in the livestock population on farms. These monthly reports, which cover cattle, sheep, and swine, show the number of each species of livestock on the farm on the first of the month when the reports are made, and for the previous months, and the following information: (*a*) Births, (*b*) purchases, (*c*) sales, (*d*) deaths, and (*e*) number slaughtered on the farm. The demands for the results of this inquiry are numerous. So far, reports have been only for the United States as a whole, State details not being given. The data for the past years are now being reworked for the purpose of furnishing the information by geographic divisions as well as by States.

### EXPANSION OF PRICE-REPORTING WORK.

The work of the division in reporting farm prices has also been considerably expanded during the year. Not only are prices secured on 68 separate farm products monthly, but a system of reports on what the farmer buys has been established. These were first gathered quarterly but will hereafter be gathered monthly. These cover 69 items grouped under eight classes. Plans have also been made to shift all of the work of gathering prices on farm products to the 15th of the month and combine all items in one schedule. This will insure the more prompt publication of those now gathered as of the first of the month and make a better distribution of the office work. Having a monthly record of prices paid as well as received will afford an excellent basis for establishing a series of index numbers on the purchasing power of farmers. Wages of farm labor and information as to supply and demand will be gathered monthly hereafter, the intention being to establish a monthly index of wages and farm labor supply.

### FUNDS INADEQUATE FOR TRUCK-CROP REPORTS.

During the year approximately 375,000 truck-crop schedules were mailed out and 105 reports were issued covering 18 crops. This work was done largely by two field specialists, who make personal surveys of the most important truck-producing regions east of the Mississippi River, and Texas, and Colorado. The field force is inadequate to cover the field properly and the time of the agricultural statisticians located in the various States is too fully occupied with other work to devote much time to truck crops. The addition of two more truck-crop specialists would greatly improve the service.

### LARGE VOLUME OF REPORTS FOR PAST YEAR.

Approximately 50,000 separate and distinct estimates of various kinds, including condition figures, yields, acreages, prices, stocks, etc., have been made for individual States and for the United States during the past year.

During the 12-month period ending June 30, approximately 4,838,000 schedules were dispatched from Washington to the regular and special correspondents covering all phases of agricultural production and prices. In addition to the schedules mailed from Washington, about an equal number was mailed from the field offices, making a total of over 9,000,000 schedules sent out during the year.

In order to secure information on the many subjects which are handled by the division it is necessary to maintain a number of separate lists of correspondents, the total number of reporters on all lists of the division now being over 260,000.

### IMPROVEMENTS IN METHODS OF ESTIMATING ACREAGES.

Real progress has been made during the past year in the development of new and improved methods of crop forecasting and estimating, especially with respect to the estimating of acreage, which

has always been one of the most serious and baffling problems of the crop estimator.

Probably the most outstanding development has been the extensive use for the first time of what is called the "field count" method of estimating changes in acreage. Briefly, this consists of the counting of the number of fields in each kind of crop along selected routes in a State, the same routes being covered from year to year, a sufficient distance being covered to be typical of the entire State. A further improvement has been made by the development of a multiple speedometer or measuring instrument, which can be attached to the automobile, by which the linear measurements can be made to determine the number of feet or yards in each kind of crop between stated points. A number of these instruments are now being constructed and it is expected that they will be generally used for estimating the 1924 crop. The results obtained by this method indicate that, knowing the total area of land in a given section, it will be possible to estimate rather accurately the distribution of the acreage among the various crops as well as in idle and pasture land. By going over the same routes two or three times during the season, the acreage planted to any crop which has been abandoned or planted to other crops during the season can also be determined.

As the field-count method is a purely objective one, the personal equation is entirely eliminated. It can be used, furthermore, when the field-measurement plan is adopted and the total land area known in estimating one year's acreage independently of any previous year, which should go a long way toward eliminating cumulative errors.

Another method which is extensively used and which through better statistical analysis has been made more useful than formerly is that of securing from thousands of farmers in each State a report each year of the acreage each farmer has sown or planted to each crop, as well as the acreage in idle and unimproved land. The acreage in the various crops for the past year as well as the current year is secured for each farm reporting, making it possible to make a direct percentage comparison with the previous year as well as to determine the ratio of the various crops to each other as well as to the total acres in the farm.

### STUDY OF NEW STATISTICAL METHOD.

A section of research has been established in the division during the past year and placed in charge of a thoroughly trained statistician. This section is now completing a study and revision of the department's estimates of acreage, yield, and production of all the principal crops for the various States back to 1866. These revisions will probably be published in the next Yearbook of the department.

Studies are also being made with a view to improving the technic of forecasting, including improvement in the methods of establishing the pars used in interpreting condition figures. Correlation studies of the relation of price and other factors to the acreage, as well as of the relation of weather to yield, are being made, all having for their object the development of a better basis for forecasting.

## DIVISION OF COTTON MARKETING.

WM. R. MEADOWS, *In Charge.*

Classification of Cotton, F. W. Knight; Preparation and Distribution of Official Cotton Standards, H. C. Slade; Future and Spot Market Investigations and Cotton Price Quotations, A. M. Agelasto; Cotton Testing, William G. Blair; Investigation and Demonstration of Cotton Standards, George Butterworth; Cotton Marketing Demonstrations, G. S. Meloy; Research in Cotton Marketing, A. B. Cox; and Cotton Handling Investigations, R. L. Nixon.

### COTTON STANDARDS ACT MADE EFFECTIVE.

The feature of the year's activities of the Division of Cotton Marketing was the enactment by Congress on March 4, 1923, of the United States cotton standards act, to become effective August 1, 1923. The chief provision of this act is the requirement of the use, in respect to classification as well as to quotations of prices, of the official cotton standards of the United States and their official designations, in interstate and foreign commerce involving any cotton for which standards may be in effect. The use of samples or private types, in good faith and not in evasion or substitution for the official standards, is permitted.

The act provides also for the licensing of cotton classers by the Secretary of Agriculture, for the classification of cotton by officers of the Department of Agriculture, and for the establishment and promulgation, in conjunction with the authorization contained in the United States cotton futures act, of official cotton standards of the United States. Under the terms of this act the standards established under the cotton futures act become effective for the purposes of this act.

Regulations were prepared and hearings were held at which the trade had opportunity to submit suggestions regarding the regulations. These were promulgated on July 21, 1923.

### UNIVERSAL STANDARDS ADOPTED FOR AMERICAN COTTON.

The principal cotton exchanges of Europe have entered into an agreement with this department to make the Federal standards the universal standards for American cotton, as the culmination of negotiations covering a number of years. With the passage of the United States cotton standards act on March 4, 1923, the desirability of an international agreement on standards became increasingly evident. Accordingly a conference was called at Washington on June 11, 1923, at which representatives from the leading cotton exchanges of Europe met representatives of the American cotton trade and officials of the Department of Agriculture and reached the agreement that the official cotton standards of the United States for grade and color of American cotton, with some slight modifications, should be adopted as the universal standards.

Arrangements were completed by Lloyd S. Tenny, assistant chief of bureau, and Arthur W. Palmer of this division, who visited the cotton exchanges of Europe this summer for the purpose. Through their efforts, agreements for the adoption of the official standards for grade and color were signed by the Liverpool Cotton Association (Ltd.), Manchester Cotton Association (Ltd.), Syndicat du Commerce des Cotons du Havre, Bremer Baumwollbörse, Centro

Algodonero de Barcelona, Vereeniging voor den Katoenhandel te Rotterdam, and the British Federation of Master Cotton Spinners' Associations. Agreements are pending with the Association Cotonniere de Belgique of Ghent and the Associazione Contoniera Italiana of Milan.

As a result of the adoption of universal standards, international cotton business will be greatly simplified and the cause of disputes largely eliminated. The same standards will now be applied to American cotton throughout its course from the farm to the factory in any part of the world. The adoption of universal standards will shorten the path between the farmer and the spinner, will increase confidence among members of the trade and should reduce handling charges with ultimate benefit to both producer and consumer.

#### HEAVY DEMAND FOR COPIES OF OFFICIAL STANDARDS.

During the fiscal year 1923, $30,339.80 was collected from the sale and revision of the practical forms of the official cotton standards and covered into the United States Treasury as miscellaneous receipts. The proceeds of the sales for the fiscal year 1922 amounted to only $8,603.80. Up to June 30, 1923, copies of the official cotton standards had been distributed as follows: Full white sets, 1,498; fractional white sets, 1,136; full color sets, 295; fractional color sets, 341; American Egyptian sets, 123; Sea Island sets, 20; full staple sets, 48; additional staple types, 2,297. It is expected that the demand for these standards will be very large during the current year.

#### CLASSIFICATION OF COTTON CONTINUES SELF-SUPPORTING.

All cotton intended for delivery on future contracts is classified by officials of the Department of Agriculture, under an amendment to the United States cotton futures act. During the past year in the regular classification work 60,823 bales of cotton were classified by the Board of Cotton Examiners at New York and 85,278 bales by the board at New Orleans. At New York 3,252 bales were submitted a second time for review and in the review the classification of 396 bales was changed. At New Orleans 1,528 bales were submitted to the board a second time for review and in the review the classification of 352 bales was changed. In addition, in the preliminary sample classification work, 3,871 samples were classed by the board at New York and 1,260 by the board at New Orleans.

The sum of $45,320.11 was collected as classification fees, including the proceeds from sales of loose cotton during the year, and was deposited to the credit of the revolving fund maintained for the conduct of the work. The classification work continues to be self-supporting and the fees are increased or decreased as the condition of the revolving fund warrants. Only slight changes in the fees were made during the year, the principal one being the elimination of the minimum of $2.50 for any lot.

#### TESTS TO DETERMINE SPINNING VALUE OF COTTON.

Investigations were made during the past fiscal year (1) to determine the comparative spinning value of superior varieties of cotton grown under weevil conditions in the Southeastern States, crop of 1921; (2) to determine the spinning value of cotton exposed to country damage; (3) to determine the comparative spinning value of

segregated Pima cotton. American Egyptian cotton was also ginned and pressed under different moisture conditions in order to determine the effect upon its spinning value, tests of which will be made during the next fiscal year.

Laboratory tests were conducted to determine the strength of individual fibers for other bureaus of the department and outside parties, as well as in connection with the spinning tests. Laboratory tests were also made to determine the strength of the yarn spun and to determine the moisture content of the cotton in the various stages of manufacture.

The results of the spinning tests of cotton compressed to different densities and of superior varieties of cotton grown under weevil conditions in the Southeastern States, crop of 1921, have been published as Department Bulletins No. 1135, Spinning Tests of Cotton Compressed to Different Densities, and No. 1148, Comparative Spinning Tests of Superior Varieties of Cotton.

The spinning tests of superior varieties of cotton showed clearly the desirability, from a spinning standpoint, of fiber produced by pure-bred strains of superior varieties of cotton over that produced from commercial seed even when grown in districts in which the reputation for character in cotton is excellent.

Spinning tests of cotton exposed to country damage have been made and the results of these tests show that the cotton, remaining after the country damage has been removed, has not been injured by the method of storing.

### CLASSING DEMONSTRATIONS AN AID TO PRODUCERS.

This project is educational in its nature and is conducted generally in cooperation with the extension service of the several States. A cotton specialist is employed and assigned as a leader of the work in each State. It is his duty to assist cotton growers in organizing into community associations. He is also charged with the supervision of the cotton classers who are employed and placed with each organized community. The classification of the growers' cotton is done as a means of instruction. The factors of value in cotton are explained to the growers and methods of marketing and the improving of the grade and character of the cotton produced are explained and demonstrated.

These demonstrations have had a very material influence on the recent efforts to organize State-wide pooling associations. In some instances the classification of cotton of such a large percentage of the growers has been undertaken by these associations, for example in South Carolina, Arkansas, and Oklahoma, that the continuance of the demonstrations seems unnecessary and they have been suspended pending the development of similar work by the associations.

This work has shown most strikingly the need for a more general adoption by communities of single superior varieties of cotton to replace the present diversity of product, the great desirability of better cooperation on the part of ginners so as to improve the grade and baling, and the need of better facilities for local storage and transportation. Improvement is marked in the average grade and in the character of the cotton produced in communities in which the demonstrations have been conducted for a series of years. The improvement has been commented upon favorably by the cotton dealers as well as by the producers.

During the year a course of illustrated lectures on the production, classification, handling, marketing, and manufacturing of cotton was given at several of the State agricultural and mechanical colleges.

#### FUTURE AND SPOT MARKET PRICE QUOTATIONS.

The purpose of this work is to secure accurate quotations on cotton and give them the widest possible publicity. The specific objects in view are (1) that cotton of grades other than middling delivered on future contracts, made subject to section 5 of the United States cotton futures act, may be settled for at actual commercial differences in value, to the end that a proper parity may be maintained between prices of future cotton and spot cotton, and (2) that producers, merchants, and others interested in spot cotton may have accurate information as to the prices of cotton, and particularly grades untenderable on future contracts.

The cotton price quotation service has been maintained in the five districts for which Charlotte, Atlanta, Memphis, New Orleans, and Dallas are headquarters. Reports of purchases and sales of cotton are gathered from country buyers, country merchants, dealers, brokers, commission merchants, factors, mills, and others who buy or sell cotton in important country markets and concentration points throughout the belt. On the basis of these reports weekly bulletins were prepared and published, showing the prices at which the various grades of cotton were actually bought and sold. The information contained in the bulletins can be obtained by the telephone and telegraph by any person who will request such service and pay the transmission expense involved. The bulletins are mailed free of charge to anyone requesting them.

Several newspapers and periodicals in the South, having a combined circulation of over a million and a half copies, are cooperating with us in this work by publishing each week reports of sales of cotton and prices at interior markets, which reports are furnished them by our field offices. Thus the quotation service is made available to a very large number of interested persons, all of whom it would be impossible for us to reach direct.

The cotton market in general was broadcasted daily by radio from all the branch offices during the last half of the year in addition to the weekly bulletin information regarding cotton prices. Plans are in the making for the more extensive use of the radio for broadcasting information regarding cotton.

### GRAIN DIVISION.

H. J. Besley, *In Charge.*

Grain Investigations, E. G. Boerner; Milling and Baking Investigations, J. H. Shollenberger; Research Laboratory, D. A. Coleman; Establishment of Grades for Barley and Rye, J. H. Cox; Grain Cleaning, R. H. Black; Bulk Handling, E. N. Bates; Federal Grain Supervision, E. J. Murphy and G. W. Morrison, Washington, D. C., and R. T. Miles, General Field Headquarters, Chicago; O. F. Phillips, Chairman, Board of Review; F. G. Smith, Inspection Efficiency; C. L. Finch, Enforcement; and B. W. Whitlock in Portland.

#### REVISION IN WHEAT STANDARDS FACILITATES EXPORT TRADE.

The classes of wheat formerly designated "Common White" and "White Club" in the official grain standards of the United States

for wheat were combined into one general class known as "White." This class was subdivided into three subclasses known as "Hard White," "Soft White," and "Western White." This change was made to facilitate the movement of export wheat from the Pacific coast under Federal standards. The use of the so-called Portland Chamber of Commerce type samples was discontinued on July 1, 1922. In addition, the name of the subclass "Red Walla" of the soft red winter wheat class was changed to read "Western Red."

### OFFICIAL STANDARDS FOR RYE PROMULGATED.

During February and March public hearings were afforded all branches of the grain industry, as well as inspectors and State officials, on the matter of official standards for rye. The standards as prepared by this division were heartily indorsed at all of these hearings, and after a few minor changes they were promulgated to become effective July 1, 1923. Urgent requests had come to the department from members of the grain trade in this country for the establishment of Federal standards for rye, and, in addition, foreign buyers made strong recommendations to the department, through the State Department, for their establishment in order that this grain might be upon the same basis as shelled corn, wheat, and oats. This demand by the domestic grain trade, as well as foreign buyers in European countries, indicates a wholesome confidence in the value of inspection certificates issued by the licensees of this department.

### REGULATIONS ESTABLISHED FOR UNIFORM LOADING OF VESSELS.

Amendments to the regulations under the grain standards act were made to provide for the uniform loading of cargo grain. The regulation provides that grain not uniform in quality and condition should be segregated for the purpose of inspection, and certificates issued on the separate lots of grain of different grades. The proper observance of these regulations will eliminate complaints from foreign buyers regarding the grade of grain exported from this country.

### STANDARDS FOR ROUGH AND MILLED RICE.

United States grades for rough rice and revised United States grades for milled rice were established as permissive standards, effective August 1, 1923, following the completion of extensive studies, and were recommended for the grading and marketing of rough rice and milled rice respectively.

Tentative grades for barley were prepared during the past year and these grades are now being applied in an investigational way to determine whether the grades are properly arranged to meet commercial needs fully. Considerable progress was made in investigations covering brown rice and flaxseed, looking toward the establishment of the United States grades for these commodities.

### REGULATION COVERING SHIPMENTS BETWEEN NONINSPECTION POINTS.

Regulations covering the interstate shipment of noninspected grain by grade between noninspection points were promulgated requiring that shippers state on invoices covering such grain that the same has not been inspected by a licensed inspector, and advising the consignees that such grain is subject to the dispute privilege under the

grain standards act. This regulation was deemed advisable in order to correct certain abuses which had developed in this branch of the industry.

### FOREIGN MATERIAL NOW SHOWN ON INSPECTION CERTIFICATE.

By direction of the Secretary, licensed inspectors at Minneapolis and Duluth were required to state on all certificates issued by them for hard red spring or durum wheat the principal kinds and quantity of foreign material when this factor determined the grade; and to show on their certificates the grade to which the grain would otherwise be entitled were it not for these factors. This requirement was in the nature of a follow-up of the know-your-own-wheat campaign conducted during the previous year.

### NEW TYPES OF GRAIN-CLEANING MACHINES.

Experiments to develop grain cleaning machines and methods for cleaning the foreign material out of the grain at the threshing machine, as part of the threshing operation, were continued. Statistics show that there was approximately 1 bushel of foreign seeds and trash (dockage) in every 23 bushels of spring wheat received at Minneapolis and Duluth during the crop movement ending August 31, 1923. If this dockage had been cleaned out of the wheat and then shipped separately to market, it would have filled over 11,383 freight cars, each containing 40,000 pounds. This represents an enormous agricultural waste. The two types of cleaning machines that were developed during the previous year were redesigned and proved to be very efficient in operation. One of the successful cleaners is especially adapted to conditions in the spring wheat section of the Central Northwest, and the other is more especially adapted to conditions found in the Pacific Coast States. Three additional types of cleaning machines for use in conjunction with the threshing machine, and which can be manufactured at a lower cost, were designed and built and will be tested during the 1923 threshing season to determine their efficiency in operation.

### PROGRESS IN FIELD WORK.

Refinement of operating methods on the part of the three projects which comprise the work of the Federal Grain Supervision, namely, inspection efficiency, board of review, and division of enforcement, coincident with increased understanding on the part of district officers of Federal Grain Supervision, inspection departments, and the grain trade, account largely for the higher accuracy of inspection, higher uniformity of inspection between markets, and the apparent greater satisfaction with the services afforded by Federal Grain Supervision. Among the major situations which arose during the past year were: Hearings at Portland and Seattle accorded to licensed inspectors for the misgrading of export cargoes; conferences with the trade and inspection department at Chicago on the subject of unsatisfactory inspection at railroad inspection points; conferences with terminal market operators from Buffalo, Detroit, Cincinnati, Cleveland, and Toledo on the subject of shipment of grain by grade between noninspection points, and the promulgation of regulations providing for the even loading of cargoes.

The merchandising of grain is becoming more specialized and technical, which suggests the necessity of constant improvement in supervision and inspection methods and in interpretations and revisions of standards to meet these developments. The general field headquarter's staff and division and district officers have cooperated with the grain investigations project in the study of the handling, transportation, and storage of grain, and in the examination of specific problems arising out of the regulatory work through the enforcement of official grain standards for shelled corn, wheat, oats, and rye. The outstanding questions in this respect which demand an early solution and to which intensive effort and study are given are: (1) Effectively cleaning grain pursuant to dockage determination under the wheat standards in order to establish the highest numerical grade possible on a given lot of wheat commensurate with its merchandising and processing possibilities; (2) improvement of grain storage on the farm with a view to enabling producers to put on the market grain of a superior quality.

#### TEST FOR OIL CONTENT IN FLAXSEED.

A simple and accurate test for determining the percentage of oil content in flaxseed was developed, which decreases the time of making a routine quantitative oil test from 24 hours to only one hour. Progress is being made on another method which will further reduce the time to approximately 15 minutes. A quick oil test for flaxseed is important as a grading factor. Several thousand analyses of domestic flaxseed made during the past year show that the oil content varies approximately 6 per cent in different lots.

#### MILLING AND BAKING INVESTIGATIONS.

Milling and baking investigations were made of the various classes and grades of wheat marketed in commerce, and special investigations were conducted to determine the influence of weed seeds, garlic, and frost and heat-damaged kernels on the milling and baking value of wheat. The data secured in these investigations were used in connection with the solution of problems arising from the enforcement of the United States grain standards act. Investigations of the milling and baking qualities of wheat varieties were conducted for the purpose of securing information which will lead to the development and production of superior wheat. Two manuscripts were prepared and accepted for publication. Our past seven years' milling and baking investigations of wheat varieties is summarized in Department Bulletin 1183, Milling and Baking Experiments with American Wheat Varieties, and in Department Bulletin 1187, Experimental Milling and Baking, is given a statement of the purpose and value of milling and baking laboratory experiments, together with a full description of the method and equipment used in connection with our investigations for the purpose of grain standards.

#### STUDIES OF METHODS OF PREVENTION OF HEAT DAMAGE IN GRAIN.

The subject of heat damage in grain was extensively studied. Investigations were conducted in the Southwest wheat-growing sections to determine the cause of heat damage in wheat on the farm, and experimental ventilators of various designs were installed in

farmers' grain bins. The experiments are not yet completed, but the results so far obtained indicate that heat damage resulting in low-grade wheat can be prevented through proper ventilation. Milling, baking, and chemical tests on samples of wheat in various degrees of heat damage were made and the data were assembled for use in connection with the enforcement of the United States grain standards act.

#### IMPROVED METHODS OF HANDLING GRAIN.

Much assistance was rendered to the grain industry in the Pacific Northwest in connection with the movement that is going on in that section of changing over from the sack method to the bulk method of handling grain. Investigations to determine the savings effected in the handling, storing, smutting, and grading of grain in bulk were conducted, and the results were made available to the grain trade, including the producers.

#### IMPROVEMENTS MADE IN GRAIN-GRADING EQUIPMENT.

Improvement was made in the design of grain-grading equipment; plug gauges were developed for determining the accuracy of the dockage testing sieves; a mold was developed for testing the accuracy of moisture flasks; gas-pressure governors were installed on the moisture testers in the offices of Federal grain supervision located in the Corn Belt and at the export market; and a new steel probe for sampling grain in cars was developed. Specifications for improved grain-grading equipment were prepared for use in securing uniform apparatus and the specifications were made public.

#### APPEALS FROM GRADE ASSIGNED BY LICENSED INSPECTORS.

During the fiscal year a total of 25,501 appeals were taken from inspections performed by licensed inspectors. Of this number 573 went to board appeal. Approximately 45 per cent of appeals filed on all grains were sustained; that is, the inspector's grade was changed and superseded by Federal-appeal grade certificates. In the case of sustained appeals no charge is made to the appellant, but in the remaining 55 per cent of appeals called which were not sustained fees were assessed and the sum of $32,471.16 was covered into the Treasury as miscellaneous receipts.

#### VIOLATIONS OF THE GRAIN STANDARDS ACT.

Fifteen cases of violation of section 4 of the law were filed by the United States attorney at Nashville against five defendants who pleaded guilty to the informations filed against them. A case involving 22 specific violations of the law is now pending in the Department of Justice awaiting prosecution. Five cases involving violation of section 5 of the act, which covers the misrepresentation of the grade of grain, as well as alteration of inspection certificates, were concluded during the year, and the Secretary published his findings, which is the penalty provided by law. In addition, the facts were published in connection with the plugging of several carloads of wheat with low-grade grain in the bottom of the cars. So-called plugged-car cases continue to come to our attention, and considerable effort has been spent during the year to break up this

fraudulent practice. The work done by the enforcement division in placing before the public the facts regarding violations of section 5 of the law has been highly commended by the best element of the grain trade. At the last meeting of the Grain Dealers' National Association a resolution was adopted calling for the expulsion from the association of any member found guilty of violating section 5 of the grain standards act.

## DIVISION OF HAY, FEED, AND SEED.

W. A. WHEELER, *In Charge.*

Hay and Feed Marketing Investigations and Market News Service, G. A. Collier and G. C.Wheeler; Seed Marketing Investigations and Market News Service, G. C. Edler; Hay Standards, E. C. Parker; Hay Inspection Service, K. B. Seeds; Broomcorn Marketing Investigations and News Service, G. B. Alguire.

### HAY STANDARDS PROMULGATED.

As the culmination of several years of intensive research work Federal grades for timothy, clover, timothy and clover mixed, mixed grass and timothy, and grass mixed hay were promulgated by the department in November, 1922. Schools for training inspectors were held in Alexandria, Va., and Auburn, N. Y., and 16 men were licensed by the department to inspect hay.

Field studies were made to determine the effect of time or stage of cutting and of soil types on the color of timothy hay when field cured or cured in the shade. Samples of hay were collected for exhibits and for use in training inspectors.

Urgent demand has been made in the West for standardized grades for alfalfa hay. Toward the close of the fiscal year steps were taken to shape investigational work toward the recommendation of alfalfa grades in the near future.

### HAY INSPECTION INAUGURATED IN SEVEN CITIES.

Federal inspection of hay was inaugurated during January, 1923, in New York City, Auburn, N. Y., Chicago, Boston, Philadelphia, Richmond, and Washington, D. C. The Chicago Hay Exchange and nearly all dealers in Chicago not members of the exchange voluntarily agreed to have all the hay received or shipped by them Federally inspected. The New York State Hay and Grain Dealers Association adopted the Federal grades and is cooperating with the department in establishing Federal shipping point inspection throughout the State. The National Hay Association passed a resolution at its annual meeting in 1923, pledging " its united support to the Department of Agriculture in devising a workable system of inspection and practical grades," and instructing and empowering its grades committee to " advise with the Department of Agriculture in the work of Federal inspection and grades and assist them in establishing grades that will promote the best interests of all concerned in the producing, handling, and consuming of hay."

### HAY-MARKETING METHODS STUDIED.

Methods of marketing hay employed by shippers and dealers both in producing and distributing sections were studied and a manuscript has been prepared for publication. Use has been made of the

information obtained in replying to special requests for such information from shippers and dealers throughout the country.

### CLEANING COTTONSEED FOR PLANTING.

Effects of delinting and recleaning on the agricultural and commercial value of cottonseed for planting purposes were studied during the fiscal year. The relation of the rate of delinting to the appearance of the seed, the percentage of seed cut by delinter saws, the time required for and total percentage of germination and weight per measured bushel or volume of 30 pounds were determined. Detailed results of these studies are incorporated in Department Bulletin No. 1219, Delinting and Recleaning Cottonseed for Planting Purposes, now in press.

Progress made by seed dealers in installing delinting and recleaning machinery is being closely followed and suggestion and assistance given whenever requested. More dealers are delinting and recleaning cottonseed each season and the use of recleaned, delinted seed is being extended with gratifying results on the part of growers. This question is of world-wide interest and inquiries upon the subject of delinting and recleaning cottonseed have been received from government agencies in India and New South Wales.

### MARKET NEWS SERVICE ON HAY, FEED, SEED, AND BROOMCORN.

The market news service has been continued along the same lines as in former years. The feed and hay news service was materially extended during the year. At the request of marketing agencies of several States, feed and hay information was furnished them several times each week and feed and hay reports were issued by the States and this department cooperatively. Information on prices, supplies, demand, movement, etc., is obtained from approximately 20 of the principal markets of the United States. The commodities covered include timothy, alfalfa, and prairie hay, straw, bran, wheat and rye middlings, cottonseed and linseed meal, hominy, gluten feed, peanut and velvet bean meal, dried beet pulp, broomcorn and all the important kinds of clover, grass, millet, and sorghum seeds.

Hay and feed information is disseminated through the daily marketgrams and fuller reports as well as reports on seed are published in Weather, Crops, and Markets. In addition to the regular weekly reviews of seed trade conditions, reports on the outlook, movement, shipment, and prices of seed were issued throughout the summer and fall when the seed crops were moving from grower to distributer.

## MARKETING LIVESTOCK, MEATS, AND WOOL DIVISION.

CHARLES V. WHALIN, *In Charge.*

Livestock Market Investigations and Grade Standardization, C. A. Burmeister; Purebred Livestock Market Investigations, L. B. Burk; Meat Market Investigations and Meat Standardization, W. C. Davis; Wool Market Investigations and Wool Standardization, G. T. Willingmyre; Market Information, C. E. Gibbons; Livestock Market News, E. W. Baker; Meat Market News, J. A. Burgess.

At the beginning of the fiscal year this division had branch offices with leased wire connections for reporting the wholesale meat

trade in Boston, New York City, Philadelphia, and Chicago, and the livestock markets in Chicago, St. Paul, Kansas City, East St. Louis, Omaha, and St. Joseph.

The market reporting service and the methods of operating it have been practically standardized, hence there is little in the way of new accomplishments to report each year, except when extension is made to other markets. Every effort has been made, however, to refine and improve the service and to utilize the most modern methods of news dissemination as they are devised.

### HOW LIVESTOCK REPORTERS FOLLOW MARKETS.

A brief description of the day's routine in one of the division's branch offices at a livestock market will outline clearly the kind of service rendered by the bureau in reporting the livestock markets. A day's work at the Chicago office, located in the midst of the world's largest livestock market, is representative, in a general way, of the service rendered at all the offices.

At 4 a. m. the employee who prepares the estimates of the number of livestock to be received for the day's trading reports for duty and calls by telephone the various railroads entering Chicago for detailed report of livestock by cars expected to arrive during the day. By 6 a. m. his reports are assembled, the results tabulated, and the estimate of the number of each species due to arrive is ready for release. These estimates are posted on bulletin boards in the exchange building and throughout the yards, filed with commercial telegraph companies, and transmitted over the bureau's leased wires to all the branch offices, and sent out to a number of agencies.

At 8 a. m. the meat market reporter telephones the wholesale markets and branch houses for information regarding meat supplies, trade conditions, market trends, and detailed prices. This information is assembled in a report which is forwarded at 9 a. m. by leased wire to the other branch offices. The reporter then proceeds to the wholesale and branch houses, where he observes trading and gathers first-hand information to use in preparing his detailed report of wholesale meat-trade conditions and prices. This report, together with the reports which have been received by leased wire from the branch offices in Boston, New York, and Philadelphia relative to trade conditions in those cities, is mimeographed and released to a mailing list of those who are especially interested.

By 8.30 a. m. those reporting the hog market have made their early rounds through the hog yards, observing trading, and are ready to send out the first market flash over the commercial and leased wires, giving the opening hog market. At 9 a. m. the cattle and sheep market reporters start on their rounds through the yards. At 9.15 a. m. the second hog flash giving development of the market to that hour is sent over the leased wires and is followed by the cattle and sheep flashes at 10 a. m. By 10.30 a. m. the reporters are ready to release a complete report with prices on all classes and grades of livestock. This report is transmitted by wire to all the offices. It pictures as nearly as possible what has transpired in the market up to that hour. At 11 a. m. the employee responsible for the preparation of the estimates releases the advanced estimates of

the number of livestock due to arrive the following day, which he has prepared in a similar manner to that released at 6 a. m.

#### DISTRIBUTION OF FINAL SUMMARIES.

The closing market report is prepared at 12.30 p. m., giving any changes that may occur after the 10.30 detailed report. In this final report each market reporter prepares a written summary of his particular market, giving detailed description of what has transpired during the day. This final report, together with summaries and detailed quotations from the other leading central markets, is mimeographed and distributed to a large mailing list.

It is usually 2.30 to 3 o'clock before the day's work of reporting the market is completed. The remainder of the day is utilized in conducting special studies and doing research work. The meat market reporter prepares special reports and prices for Washington and the eastern offices; he also writes monthly and weekly summaries of conditions in the wholesale meat trade and compiles reports on retail market conditions and prices. The livestock market reporters prepare special reports, weekly summaries, and weekly reviews for the branch offices located in eastern meat consuming centers and for agricultural and trade papers. Reviews and other items are also prepared for Weather, Crops, and Markets, the official market publication of the department, published in Washington.

The Postal Telegraph Co., the Western Union Telegraph Co., the Associated Press, the Illinois News Bureau, and the Illinois Agricultural Association are news-disseminating agencies which take part or all of the various reports released by the Chicago office in furnishing news to their subscribers. Complete reports of the Chicago and other principal markets are prepared for broadcasting from three radio stations operating in or near Chicago. In addition, several special market wires are prepared each day for individuals and commercial concerns interested in only certain features of the market.

#### MEAT REPORTS FOR THREE PRINCIPAL EASTERN CITIES.

Wholesale meat-trade information secured in three principal eastern markets is collected and disseminated in the same manner as that outlined under livestock market reports above. In addition to preparing mimeographed reports covering conditions at his market, the reporter releases a number of miscellaneous reports prepared in Washington and in the other branch offices which are of particular interest to the livestock and meat industries. He is always ready to respond to special requests for information and at some of the offices he prepares reports for radio broadcasting and for publication in trade and commercial papers.

The representatives at the three eastern markets also compile information desired by the Washington office regarding imports and exports of livestock, meats, wool, and other animal products. In addition they compile records showing the volume of western dressed and local slaughtered meats received in their cities.

Under a cooperative agreement with the State authorities in Missouri, a branch office was maintained at St. Joseph, Mo. The reports of the St. Joseph market were transmitted by leased wire to Jefferson City, where they were broadcasted by radio, in addition

to the usual dissemination through the press and to individuals requesting the reports. It was necessary to close this office on account of lack of appropriation, although the service was very popular and many protests were made when the distribution of these reports was discontinued.

#### LOS ANGELES AND SAN FRANCISCO RECEIVED SERVICE.

A local livestock-market reporting service was established at Los Angeles and San Francisco, through a cooperative agreement made with the State division of markets of the California Department of Agriculture, in response to requests from California cattlemen. Every effort was made to obtain the widest dissemination through the press, the radio, and through producers' organizations. Daily reports were furnished the press association and the metropolitan newspapers, and weekly summaries were prepared for country newspapers and farm journals.

#### REPORTS ON CALIFORNIA LAMBS ASSIST PRODUCERS AND TRADE.

California, on account of its strategic location, is the first early large commercial lamb-producing district in the United States, and probably the most distant from the larger centralized livestock markets. Early in the season the San Francisco representative attended a meeting of the producers and of the executives of the leading railroads traversing the districts having transcontinental connections to the large livestock markets to work out a fast service schedule which would put California lambs on the Omaha market in seven days and to Chicago in eight days. Through the cooperation of the shippers with the carriers this service was maintained throughout the season and resulted in moving 1,970 carloads of spring lambs during the period of March 15 to June 3 out of the State.

As the spring-lamb season progressed a drought developed in the San Joaquin Valley which promised to curtail production by the loss of thousands of lambs. This lack of rain cut down pastures and prevented the young lambs from becoming fat enough to find outlet for immediate slaughter, thus producing a larger number of thin lambs suitable for a short turn on green pastures in other sections of the State and for feeding purposes in other States.

A quick detailed survey was made and telegrams dispatched to all local offices of the bureau through the Washington office, which resulted in considerable inquiry from Texas, Colorado, Nebraska, and territory contiguous to Chicago as to the quality, average weights, range in weight, and prices f. o. b. cars in the San Joaquin Valley, while local publicity given the situation resulted in moving these lambs to other counties in the State. The gravity of the situation was presented to the railroad companies, which in turn published feeder rates and drought rates for the movement over the various railroads and resulted in a one-way rate within the State from points in the San Joaquin Valley on the round trip. The movement saved many ewes which otherwise might have been lost to potential production. The exact number of cars moved can not be definitely determined, but officials of the railroads stated that the movement was large in the aggregate.

### OFFICE OPENED AT FORT WORTH.

On December, 1922, a branch office was located at Fort Worth, Tex., and a news service begun for the benefit of the local trade. Reports are also disseminated through the press, commercial telegraph companies, and by radio.

A limited service was given on livestock at Atlanta through cooperation with the Crop Estimates Division. During the present fiscal year a more complete service will be possible at this and other points.

### NEWS SERVICE ON WOOL BEGINS.

Weekly reports on wool conditions throughout the range States were secured through the bureau representatives for the producing areas during April, May, and June of this year. This information was assembled and transmitted by wire to the division's branch offices for mimeographed release and for general publication. A mimeographed publication, Wool Notes, has been issued on the first of each month. This carries information on conditions and prices in the United States and abroad, a review of wool conditions in the farm and range States, a summarized statement of monthly consumption of wool, and detailed figures on imports of wool at Boston and Philadelphia. Quarterly stock reports were continued, showing the stocks of wool in the hands of dealers and manufacturers.

### WIDE PUBLICITY FOR CURRENT INFORMATION.

Without additional cost to the Government a very much wider dissemination of the information on prices and market conditions has been secured. Special reports are prepared by this division for both the United Press and the Associated Press to send to the various newspapers subscribing to their service and for the Western Union and the Postal Telegraph companies as a special feature in their Commercial News Dispatch service, commonly known as the C. N. D. service. Radical changes were made during the year in the form of the reports furnished these press associations, and it is generally accepted that the reports have been greatly improved. Branch offices prepare special weekly reviews of livestock market conditions for the Associated Press. The distribution of these reports through the press associations makes it possible for practically every newspaper reader in the country to have access to the bureau's market reports without delay.

### LIVESTOCK STANDARDS WELL RECEIVED BY TRADE.

Results obtained during the year in connection with the development of standard grades for livestock were gratifying. Standardization of grades for these products has been given attention since the inauguration of the livestock market news service in 1917, but did not attract attention of producers and the trade until the past year. Not only have many inquiries been received regarding the work being done, but there has been a demand for literature and demonstrations to show how the standards might be applied in actual practice. Leading trade journals have manifested an active interest in the subject and one of them conducted a vigorous campaign for the purpose of educating its leaders as to the need of a standard

classification and as to the merits of the one worked out by the bureau.

The bureau's market classification for livestock was revised and practically all objectionable features eliminated. The revised classification, modified and elaborated to make it suitable for all possible conditions in various parts of the country, is without doubt the most complete classification for meat animals ever available, and constitutes a long step forward in standardization. The demonstrations conducted for the purpose of educating producers regarding the practicability of the standard classifications for livestock and wool have aroused such keen interest that the demands for further demonstrations are greater than can be met with the force available.

### CLASSES AND GRADES FOR DRESSED MEATS PROVE VALUABLE.

The work of standardizing classes and grades of dressed meats has fully paralleled that done with respect to livestock. A bulletin on Market Classes and Grades of Dressed Beef was submitted for publication. Another step along the line of promulgating grades for dressed meat and demonstrating their practicability was taken when complete specifications covering beef, veal, lamb, mutton, pork, and miscellaneous meats were prepared and distributed among public institutions, interested organizations, and individuals. These specifications describe the different classes and grades so clearly that firms contemplating entering bids for meat contracts have no difficulty in understanding precisely the grade of meat required, and institutions making such purchases are in a position to enforce their wishes by requiring that all meats supplied conform to the specifications outlined. The specifications have met with virtually universal approval and it is expected that when they become generally distributed and understood they will do much toward simplifying trading in meats.

The standardization program was extended to include methods of cutting meats. Methods of reducing meat carcasses to wholesale and retail cuts vary widely. This leads to considerable waste, not only of edible meats but of time, effort, and money, and makes it practically impossible to compare prices prevailing on the various markets. The elimination of this confusion and waste can be accomplished only by establishing standard cutting methods throughout the country. In order to accomplish this, Department Circular 300, Commercial Cuts of Meat, illustrated with charts showing methods of cutting recommended, has been prepared for publication.

### ECONOMIES EFFECTED FOR UNITED STATES SHIPPING BOARD.

The practical value of standard classes and grades and standard methods of cutting meats was fully demonstrated when the United States Shipping Board requested the bureau to ascertain why the meats delivered to its various steamships on contract were unsatisfactory. Investigation disclosed that most of the trouble was due to lack of standard specifications. The Shipping Board then requested the bureau to inspect all meats, poultry, and fish offered to the United States lines on contract and require that they comply with the specifications drawn up by the bureau and adopted by the Shipping Board as the standards on which such products would be

purchased. The inspection service resulted in great economies to the Government. Furthermore, it increased the competition on the part of dealers for the business and eliminated wide price spreads, which had prevailed before the inauguration of the inspection service.

### WOOL STANDARDS PROMULGATED.

Establishment of official wool standards of the United States for grades of wool was effected after several public hearings at which leading representatives of all branches of the wool industry, including producers, merchants, and manufacturers, were invited to offer their suggestions and recommendations based on the tentative wool grades. Specifications defining the grades were prepared and published as Service and Regulatory Announcement No. 75, Official Wool Standards of the United States for Grades of Wool. Studies are now being made to determine the correlation between the grades of wool and the different breeds of sheep, and plans are being made to determine the amount of shrinkage from scouring in the various grades and in the wool produced in different sections.

Steps have been taken looking toward the establishment of universal standards for wool. Mr. G. T. Willingmyre, of this bureau, was sent to Europe to confer with members of the wool trade in an effort to work out standards for wool which will be universally acceptable. Advices as to prospects are encouraging.

Progress was made in the collection and analysis of market data needed in the development of plans for the more orderly marketing of livestock. The data obtained show the principal sources of supply of the different classes and grades of meat animals, the final disposition, the seasonal marketings, and such other information as will be needed in forecasting probable future supplies of meat animals and market movements.

### PRICES OF PUREBRED ANIMALS ANALYZED.

Semiannual surveys were inaugurated to obtain information regarding the prices and number of purebred animals sold at auction and private sales. The first survey was made to cover the calendar year 1922, some 15,000 producers being sent schedules and requested to report the number, sex, and age, and the maximum, minimum, and average price received for the different classes of breeding animals sold. The results of these surveys are being tabulated and analyzed for publication and will provide the first authentic information regarding actual prices paid for purebred stock. This information will tend to check the exploitation of the purebred industry and should encourage the use of better breeding stock, thereby increasing the value of all the livestock in the country.

### BETTER LAMB MARKETING DEMONSTRATED.

Complaints regarding violent fluctuations in lamb prices at the Jersey City livestock market resulted in an investigation to determine the reasons therefor and the working out of plans to encourage raising of better lambs by the use of improved methods and better breeding stock and development of more orderly marketing. A campaign was conducted among eastern sheep raisers urging the

elimination of "bucky" lambs. Material results can not be expected in the course of one year, but the interest manifested by producers was gratifying and reports indicate considerable progress.

## DIVISION OF DAIRY AND POULTRY PRODUCTS.

ROY C. POTTS, *In Charge.*

Dairy Products Investigations, D. L. James and C. W. Fryhofer; Poultry Products Investigations, J. M. Borders and R. B. Slocum; Market News Service, L. M. Davis; and Dairy Inspection Service, C. W. Fryhofer.

### DEMAND INCREASES FOR MARKET INFORMATION.

The market news service reports on dairy and poultry products were in greater demand by the dairy and poultry industry than ever before. These reports contain accurate and reliable information on supply, demand, movement, and prices, and are now furnished to a mailing list of more than 20,000 firms. The value of these reports in giving greater stability to market conditions, thereby eliminating the sudden fluctuations so ruinous to shippers and dealers, is obvious and accounts largely for their increased demand. At the four markets, Chicago, New York, Philadelphia, and San Francisco, the compilation of statistics on receipts has been abandoned by the trade organizations, in recognition of those compiled at the branch offices of this department. Further confidence in these reports was evidenced by the fact that many firms used them as a basis for prices on which settlements were made on contracts with country shippers.

Two bulletins, designed to aid in efficient marketing, Farmers' Bulletin 1377, Marketing Poultry, and Farmers' Bulletin 1378, Marketing Eggs, were written during the year and are now in press.

### BUTTER INSPECTION MAINTAINED AT SIX MARKETS.

The butter inspection service maintained at Boston, New York, Philadelphia, Washington, Chicago, and San Francisco was received with increased favor and confidence in 1923, as evidenced by an increase in the number of inspections made and especially by the use of the service as a basis for settlements with shippers on contracts which specified Federal inspection for the determination of quality. This service also was used by a number of firms which desired to obtain butter of satisfactory keeping quality for storage.

### WORK TOWARD STANDARDIZING EGGS.

The need of standardized grades for eggs has long been recognized. Studies in egg standardization conducted by the bureau resulted in the publication of a circular outlining tentative standards including classes and grades. The importance of quality in eggs was emphasized in a circular entitled "Build a Reputation for Quality Eggs."

### EXTENSION WORK IN EGG HANDLING.

An egg standardization campaign was conducted in the State of Missouri in cooperation with the Missouri State Marketing Bureau. During this campaign demonstrations of proper methods of candling, grading, and packing eggs for market were made at more than 400

local markets and the importance of quality in eggs emphasized. An awakened interest in the production and marketing of better quality eggs was developed, and egg shippers and dealers in Missouri reported considerable decrease in the percentage of seconds and lower quality eggs marketed by farmers.

An extensive survey of egg-marketing methods and practices in the State of Virginia was started during this year. This was preliminary work leading up to the organization of egg producers for marketing purposes. The purpose of this survey was to ascertain the possible volume of eggs which might be offered for sale through a cooperative association, and to ascertain the extent of the interest actually taken in the proposed cooperative plan by producers themselves. As a result of this survey, the Virginia Poultry Producers Cooperative Association was enabled to adopt a marketing program.

## DIVISION OF FRUITS AND VEGETABLES.

WELLS A. SHERMAN, *In Charge.*

Market News Service, Edwin W. Stillwell; Inspection Service, F. G. Robb; Grades and Standards, H. W. Samson; Standard Containers, H. A. Spilman; Research Studies, H. W. Samson.

### MARKET NEWS SERVICE EXTENDED TO SOUTHWEST.

An important extension of the leased-wire news service on fruits and vegetables made during the past year was from Kansas City to Fort Worth and Austin, Tex. While branch offices were maintained in 12 cities, the leased-wire service was made available at a number of other points through cooperative arrangements with various States.

Thirty-eight temporary field stations were operated in important producing sections during the heavy movement of crops in addition to the 12 market stations. A list of these market stations and field stations, together with the number of mimeographed reports issued from each, is as follows:

MARKET STATIONS AND REPORTS ISSUED.

| | | | |
|---|---|---|---|
| Washington | 2,169,760 | Boston | 227,477 |
| Los Angeles | 529,606 | St. Louis | 167,294 |
| New York | 467,636 | Pittsburgh | 142,624 |
| Philadelphia | 429,972 | Baltimore—reports released from Washington. | |
| Chicago | 406,823 | | |
| Minneapolis | 373,032 | | |
| Kansas City | 326,145 | Fort Worth—reports released by radio. | |
| Cincinnati | 238,378 | | |

FIELD STATIONS AND REPORTS ISSUED.

| | | | |
|---|---|---|---|
| Presque Isle, Me | 296,907 | Kearney, Nebr | 39,889 |
| Grand Rapids, Mich | 246,202 | Sanford, Fla | 30,472 |
| Idaho Falls, Idaho | 231,422 | Brawley, Calif | 22,297 |
| Waupaca, Wis | 213,205 | Fort Valley, Ga | 22,039 |
| Spokane, Wash | 187,994 | Hastings, Fla | 21,084 |
| Rochester, N. Y | 173,950 | Macon, Ga | 17,237 |
| Greeley, Colo | 77,567 | Monett, Mo | 16,082 |
| Alliance, Nebr | 65,835 | Thomasville, Ga | 16,052 |
| San Benito, Tex | 61,820 | Hammond, La | 15,244 |
| Benton Harbor, Mich | 60,105 | Laredo, Tex | 14,474 |
| Caldwell, Idaho | 53,631 | Jacksonville, Tex | 11,182 |
| Monte Vista, Colo | 44,097 | Judsonia, Ark | 10,949 |

| | | | |
|---|---|---|---|
| Ocala, Fla | 10,759 | Cornelia, Ga | 4,917 |
| Rocky Ford, Colo | 10,071 | Aberdeen, N. C | 4,663 |
| Elizabeth City, N. C | 9,936 | Bowling Green, Ky | 4,198 |
| Sulphur Springs, Tex | 9,687 | Crystal Spring, Miss | 3,951 |
| Charleston, S. C | 9,289 | Kennett, Mo | 3,678 |
| Crystal City, Tex | 8,785 | Phoenix, Ariz | 3,277 |
| Chadbourn, N. C | 7,225 | Hempstead, Tex | 2,090 |

SUMMARY OF ALL FRUIT AND VEGETABLE REPORTS.

| | |
|---|---|
| Total regular market reports issued from market stations | 5,075,100 |
| Special reports issued from market stations | 403,647 |
| Total reports of all kinds issued from market stations | 5,478,747 |
| Total regular market reports issued from field stations | 2,042,262 |
| Grand total of all reports issued from all stations during year | 7,521,009 |

Communication was maintained with these various field stations by commercial wire directly from Washington or by relay from the nearest market station. Waupaca, Wis., was connected with the Minneapolis leased-wire circuit. In a large number of producing sections assistance has been given by State agencies or by growers' and distributors' organizations in meeting the expense of this service. Although there were no funds available for the extension of the service, except to Fort Worth, as mentioned above, a material increase was made in the usefulness of this service through the cooperation of the various States.

Cooperative arrangements were continued with Pennsylvania, New Jersey, Ohio, and Wisconsin, and for a part of the year with Nebraska and Texas. These States cooperated with the Federal bureau in securing as well as distributing important items of market information on various crops, thus aiding materially in widening the dissemination of the daily market reports. This work is done largely through the daily press in these States and through mailing lists in the various localities. In addition, many of the States broadcast the reports by radio.

### NEW REPORTS ON CAR-LOT SHIPMENTS BY CARRIERS.

An important improvement was made in the system of securing reports from the carriers on car-lot shipments of fruits and vegetables. Formerly these reports were received from 1,275 division superintendents and other officials reporting about 500 lines. This necessitated a large number of commercial telegrams and consequently a heavy expense to the bureau. A system was devised whereby the division superintendents render their daily reports to the general superintendents, who consolidate the information and send it to Washington in one wire for the entire railroad or for a particular region. Thus far 35 railroads have adopted the new method of reporting their shipments. These daily reports show the number of cars forwarded from each State of origin, the information being segregated by products. Temporary field stations receive copies of the reports from division superintendents, showing the primary destination of all shipments in that region. In some cases the reports of diversions also are obtained for field stations. Shipment information is distributed daily from Washington by leased wire, by radio, and in mimeographed form. Market and field sta-

tions, in turn, distribute it to a wide circle of interested persons. The complete national shipments of the commodities on which each field station is issuing reports are telegraphed to that station for the information of growers and shippers.

Monthly reports showing stations of origin are received on 37 products from about 14,000 local freight and express agents. These statistics are especially valuable because they show the exact sources of supply.

### UNLOAD REPORTS FROM TWENTY ADDITIONAL MARKETS.

Daily reports on the unloads of the principal fruits and vegetables from railroads and express companies, and similar information is secured from boat lines in a large number of important central markets. During the past year arrangements were effected with agents of the transportation companies in twenty additional markets and these reports have been received regularly on the following commodities:

| | | |
|---|---|---|
| Apples. | Onions. | Sweet potatoes. |
| Cabbage. | Peaches. | Tomatoes. |
| Cantaloupes. | Strawberries. | White potatoes. |
| Celery. | | |

The unload statistics for the past few years have been mimeographed on separate sheets for each city and have been used in the preparation of bulletins. They are in great demand by transportation lines, members of the trade, growers, and shippers, as the figures show the total annual supply and the sources of supply for these markets, as well as the unloads by months throughout the year.

### SHIPPING-POINT INSPECTION SERVICE ESTABLISHED.

The outstanding development in the inspection service during the past year has been the inauguration of the shipping-point inspection service.

Congress authorized the shipping-point inspection work by amending the law under which this service is rendered, but provided no additional appropriation to carry on the work. It was necessary, therefore, to inaugurate this work through cooperation with State agencies which had funds at their disposal or authority to use the fees collected as a revolving fund for carrying on the work. Cooperative agreements covering inspection at shipping points have been entered into with the following States:

| | | |
|---|---|---|
| California. | Missouri. | South Carolina. |
| Colorado. | Montana. | South Dakota. |
| Delaware. | Nebraska. | Texas. |
| Florida. | North Carolina. | Utah. |
| Georgia. | New Jersey. | Virginia. |
| Idaho. | New York. | Washington. |
| Illinois. | North Dakota. | West Virginia. |
| Maine. | Oregon. | Wisconsin. |
| Massachusetts. | Pennsylvania. | |

The larger part of this work has been done in a few States having laws under which the fees collected for the work can be used as revolving funds. It has been impossible to start the work in many States, as no authority exists.

The total number of shipping-point inspections for the fiscal year 1923 was 72,666. Colorado led with 24,815 inspections; California, Idaho, and Washington followed with 17,778, 13,338, and 8,917 inspections, respectively. It should be noted also that of the 72,666 inspections only 61 requests for reinspection were made, and of this number 34 inspector's reports were reversed as to grade.

### COOPERATION WITH THE STATES.

Although detailed arrangements for shipping-point inspections have differed in almost every State from those of almost every other State, the prevailing type of cooperative agreement has provided that the State collect and disburse the fees. The State has also hired the inspectors, while their training and supervision has been left to this department. A small share of the fees collected has gone to the Federal Treasury to offset this cost of supervision.

In some cases the best arrangement which could be made with the State has been unsatisfactory, but every means has been resorted to in order to place the service within the reach of the largest possible numbers of shippers.

Some of the economic results of the shipping-point inspection service have been spectacular in the swiftness of their movement and bid fair to leave a lasting impress on the fruit and vegetable industry. By bringing the lessons of proper grading and standardization home to the growers it seems evident that production methods in many districts will be profoundly affected. Jealousy and suspicion, which too often attach to the work of the inspector employed by the local cooperative association, does not attach to the work of the Federal inspector. The certificates thus issued have been found a new and satisfactory basis for pooling by organized growers who have never been able to solve this problem in the past. The shipper was furnished with a new basis upon which he could offer his product to the purchaser in the distant market and was able to have in hand when the car left his station prima facie evidence that he had made a good delivery. The purchaser on the other hand has been given a new method for specifying exactly what the shipment shall be, and if he buys demanding "Government certificate attached to bill of lading" he can be sure that an impartial agency has passed upon the quality of the goods which will be shipped him.

### NEW METHODS OF SELLING HAVE RESULTED.

Capitalizing this situation, enterprising business men have established auctions in eastern and western cities, the sole business of which is to sell cars in transit on the strength of the Government inspection certificate. The auctioneer in Pittsburgh, for instance, had in hand a telegraphic summary of the result of the Government inspection on a car of California products which left the shipping point the evening before. The car is offered for sale on this description. The buyers purchase on an f. o. b. shipping-point basis with no other evidence of what the car contains than that carried in this telegram.

The car is sold, purchase price is transmitted to the shipper by wire, and the transaction is completed within less than 48 hours after

the car is loaded. It proceeds at once to its destination without indirection or delay when neither auctioneer nor purchaser has ever seen even a sample of the goods. Furthermore, the buyers need not attend these auctions in person, but houses in cities hundreds of miles away can do business at these auctions through resident buying brokers by stating the size, variety, and grade of the product desired and the character of the containers in which packed.

On the first 500 cars of California cantaloupes thus sold there was a net saving in commission to the shippers of 10 per cent of the f. o. b. price of the goods.

The first year's experience in shipping-point inspection, which of necessity has been largely experimental, although developing a volume of business more than twice as great as that done in all of the markets combined, indicates that when this service is fully developed it is likely to call for the services of not less than a thousand inspectors per annum, although many of them may be part-time men. Every State in which the work is being conducted successfully on a large scale is using the fees to support the work, and it is believed that in no other way can the Federal service be given the elasticity and be put upon a correspondingly self-sustaining basis. If this is not to be done it will be necessary eventually that appropriations be made of not less than $1,000,000 per annum, upon which the department can draw to finance this work as may be required.

It is noteworthy that while the inspection work at terminal markets had reached a point in the fiscal year 1922 where five-sevenths of the appropriation was returned to the Treasury in the form of the fees the combined market and shipping-point inspection work, for the fiscal year 1923 has returned to the Treasury six-sevenths of this appropriation, notwithstanding the fact that the introduction of a new service of this sort has inevitably resulted in a small net cost to the Government in far more than half of the States. The substantial excess of fees over expenditures in certain territory indicates clearly the possibility of extending this work on a self-supporting basis to a very large proportion of the shippers of the entire country whenever the department is given a freedom approximating that of other business institutions in financing the enterprises for which they are responsible.

### RECEIVING-POINT INSPECTION SERVICE.

During the fiscal year ending June 30, 1923, inspections were made by Federal inspectors with offices located in 32 important markets. Inspections were made, however, at a total of 296 unloading points, covering a total of 28,169 inspections at terminal markets. Compared with the fiscal year 1922 this shows an increase of 2,291 inspections of fruit and a decrease of 5,329 vegetable inspections.

The decrease of 3,038 cars in the total number of inspections made in 1923 is due chiefly to the loss of inspections for the railroads in some cities. This loss has been due, first, to the inability of the small inspection force of the bureau to handle the work requested by the railroads within the necessary time; second, the objection of the railroad to the payment of the regular fee for such a large number of inspections, as they believe that this fee is excessive for their

work, because in many cases there is nothing wrong with the shipments and they wish the inspection merely as a protection against possible unjust claims.

An important change in the food-products inspection law for the past fiscal year made it possible for the bureau to inspect shipments at points other than designated markets. This allowed inspections to be made at many small terminal markets, which has been a great convenience to many shippers.

### NEW GRADES AND STANDARDS.

Tentative grades were prepared during the past year for prunes, apricots, boxed pears, and boxed apples, and studies were made looking to the formulation of grades for sweet peppers. The grades formerly recommended for barreled apples were slightly revised and have now been adopted as the official standards in five of the leading apple States. Investigations have been made with a view to establishing grades for canned tomatoes.

The principal efforts of this project were devoted to the practical use and adoption of the various recommended grades throughout the States. Working closely with the inspection project at shipping points, much headway has been made in getting growers and shippers to see the fundamental importance of proper standardization of fruits and vegetables and their containers. Generally recognized and acceptable standards for the different products are essential to an intelligent and successful system of inspection at shipping points.

In connection with the shipping-point inspection service standardization studies have been carried on in a number of States and grading-demonstration work has been conducted on a number of products. Exhibits and demonstrations of grading were made at a number of State fairs and conventions.

In cooperation with the Bureau of Entomology bee-culture laboratory color determinations were made for the purpose of fixing definite color standards for honey.

### RESEARCH IN MARKETING FRUITS AND VEGETABLES.

A study begun last year of the records of 21 fruit-auction companies has been completed. This study aims to bring out facts concerning the ownership, control, methods, and position held by auction companies in the present scheme of distribution. A report covering this study is being prepared.

Preliminary reports have been submitted covering the study made of the methods of financing the production of fruits and vegetables. These reports cover the production of peanuts in the Virginia-North Carolina and Georgia-Alabama districts, and the following Florida crops: Cabbage, celery, citrus fruits, cucumbers, lettuce, strawberries, tomatoes, and white potatoes.

A survey was made of the harvesting, handling, and marketing methods employed in the cabbage-producing sections of western New York, northern Ohio, and Wisconsin. The data collected are in process of preparation for publication and will furnish valuable information regarding the proper methods of preparing cabbage for market

### STANDARD CONTAINER ACT IS EFFECTIVE.

The enforcement of the standard container act met with little serious opposition and in general has received the hearty cooperation of the manufacturers during the past year. In securing this cooperation, however, it has been necessary to visit the various factories and make tests of a very large number of containers. Visits were made during the year to 67 factories and an examination made of 3,613 sample containers. In 1922, 2,284 containers were tested and in 1921 only 466. The great increase in the receipts of samples to be tested makes one of the greatest problems the handling of this work with expedition. Effort is being made to work out more definite specifications for the use of the manufacturers, and suggestions regarding methods to be used to safeguard capacity have been sent to all manufacturers.

Of baskets directly affected by the standard container act; namely, climax baskets, berry boxes, and till baskets, the percentage of those tested found to be standard increased from 62 per cent in 1920 to 80 per cent in 1923. Of baskets indirectly affected by the act, namely, hampers, round stave baskets, and market baskets, the percentage rose from 40 per cent in 1920 and 1921 to 59 per cent in 1922, but dropped back to 49 per cent in 1923. Taking the two classes as a whole, the percentage of those tested found to be standard has increased from 53 per cent in 1920 to 76 per cent in 1923. The subject of standard crates and boxes for fruits and vegetables should be given more attention than has been possible to give it under the very limited appropriation available. There is a genuine interest in this subject in many quarters and a need for standardization.

### COLLECTION AND DISTRIBUTION 1918 EXCESS WOOL PROFITS.

WELLS A. SHERMAN, *In Charge.*

W. L. EVANS, *Assistant.*

During the fiscal year 1923 the Domestic Wool Section has directed its efforts particularly toward the settlement of pending cases and the distribution of excess profits to woolgrowers. The total amount of ascertained excess profits made on wool during 1918 is $1,478,793.57. Of this amount $734,235.92 has been collected and $381,275.13 has been distributed to woolgrowers, of which $66,115.75 was mailed to woolgrowers during the past year. Total collections during the year aggregated $112,571.27.

Of the amount yet to be collected $596,000 is due from 43 dealers whose cases have been referred to the solicitor for collection through legal procedure. During the past year four cases have been tried and three decided in favor of the Government. Judgment has not yet been rendered on the fourth case. The right of the Government to collect excess wool profits has been sustained by the Federal courts in eight judicial districts.

## DIVISION OF WAREHOUSING.

H. S. Yohe, *In Charge.*

Grain Warehousing, H. K. Holman, jr.; Wool Warehousing, C. Nagel; Tobacco Warehousing and Standardization, F. B. Wilkinson.

The year 1923 marked the greatest progress in the licensing of public warehousemen under the United States warehouse act for the storage of agricultural products since its passage in 1916.

During the past fiscal year the licensed capacity of cotton warehouses increased from 1,210,000 bales to 2,639,200 bales, grain from 14,450,000 bushels to 20,297,047 bushels, wool from 27,500,000 pounds to 32,100,000 pounds, tobacco from 68,400,000 pounds to 219,475,000 pounds. Thus the licensed capacity for cotton has been more than doubled; the tobacco capacity has been more than trebled. A substantial increase has also been made in the licensed grain-storage capacity.

Much of the progress made is attributable to the attitude taken by growers' cooperative associations and bankers toward receipts issued under the law. A number of cotton and tobacco growers' cooperative associations adopted rules that they would not place cotton or tobacco with any warehousemen unless they were licensed by the department. The attitude of bankers is shown in the following resolution adopted on June 25, 1923, by the New Orleans Clearing House Association:

*Resolved*, That the New Orleans Clearing House Association, recognizing that Federal bonded warehouse receipts are preferable for collateral purposes, and that the safeguards offered by the Federal warehouse system through its selection in admitting warehouses into the system, its supervision and inspection of warehouses, and the bonded responsibility of the warehousemen are to the interest of financial institutions handling warehouse collateral as well as the patrons of such warehouses, including producers and merchants, hereby expresses itself as favoring the licensing of warehouses under the United States warehouse act and urges upon warehousemen in the State of Louisiana to operate their warehouses under this statute.

Similar resolutions were adopted by other clearing-house associations. The Federal Farm Loan Board, in administering the intermediate farm credits act of 1923, in its preliminary rules and regulations included a rule reading as follows:

Intermediate credit banks will accept the receipt of any warehouse licensed and bonded under the Federal warehouse act.

### WAREHOUSING AS AN AID IN COOPERATIVE MARKETING.

The formation of cooperative growers' associations, the War Finance Corporation, the Federal intermediate credits act, and the attitude of large banks are all encouraging the producer to hold his crops for a longer period after harvesting and thus encouraging more orderly marketing. The Federal warehouse act has clearly demonstrated its value in this movement.

The supervisory work of the department in administering this law is proving of value to patrons of the warehouses as well as to insurance interests, as evidenced by the fact that during the year the underwriting associations in the Pacific Coast States have extended a credit of 10 per cent in insurance rates on both the warehouses and the contents stored therein.

Until February 23, 1923, the act applied only to cotton, grain, wool, and tobacco. On that date the law was amended to apply to such agricultural products as the Secretary might consider properly storable under the act. Already the department has received requests from a number of sections for licensing warehouses for the storage of beans, eggs and other cold-storage products, apples, potatoes, peanuts, pecans, canned goods, broomcorn, onions, cottonseed, cane and maple sirup, flour, sugar, hay, and other products. As fast as the necessary trained men can be added to the staff, warehouses for the storage of products other than the four staples originally covered by the act will be proclaimed licensable.

### STEPS TOWARD TOBACCO STANDARDS.

In the field of tobacco standardization, much progress has been made. Tentative standards have been established covering the dark-fired, flue-cured, and sun-cured types of tobacco of Virginia and the Carolinas, and the dark-fired tobacco of Kentucky. These standards were used by the cooperative associations of those States in the past year.

Tentative standard lengths for cigar leaf tobacco were also established and have been used by the Cigar Leaf Tobacco Growers Association in Wisconsin. Standard lengths and grades have been developed covering the principal cigar leaf tobacco produced in the Connecticut Valley. These will be used by the Connecticut Valley Tobacco Growers Association for the 1924 crop. It is estimated that two-thirds of the total tobacco production for the country will be marketed in 1924 under the tentative standards prepared by the Department, despite the fact that less than three years ago there was a general feeling that standards could not be developed for tobacco.

Special investigations were made covering the classification of cotton in the hands of one of the cotton growers' associations. Special investigations were also made relative to the delivery of products contrary to the law and regulations. As a result of these investigations one case has been turned over to the Department of Justice for prosecution.

Investigations have been started to secure data preliminary to drafting regulations for the storage of peanuts, broomcorn, and potatoes.

## DIVISION OF COST OF MARKETING.

A. V. SWARTHOUT, *In Charge.*

Information on costs of marketing livestock has been gathered, and mimeographed pamphlets have been issued from time to time covering the costs of marketing livestock. As this information covers a period of one year only, positive statements as to costs and trends can not yet be made. It was found that a large number of variable factors which influence cost were not easily measured and in many cases were not possible to ascertain. Much valuable information has been secured, however, and it is planned to issue a complete report on the cost of marketing livestock in the Corn Belt States in the near future. In cooperation with the State of Ohio, a study was made of the operations of eight county-wide associations

in the State of Ohio for the year 1922. These data are now in process of tabulation.

### COSTS OF RETAILING MEAT.

In cooperation with the bureau of business research of Northwestern University a system of accounting was devised for retail meat stores. This system is now being actively installed in Chicago, Cleveland, and New York City and monthly reports are being received by the joint office in Chicago from approximately 150 retail meat dealers. It is planned within the next two or three months to issue a report based on reports for six months.

Questionnaires are being sent to 20,000 retail meat dealers asking them to submit profit and loss accounts for the year ending December 21, 1922. These should furnish figures which can be used for comparison with the 1923 data. The work in New York City will be continued on a somewhat less extensive scale until about April, 1924, when there will be available a complete year's record, by months, of the operations of this group of dealers. These data will furnish fundamental facts relating to the retailing of meats.

### COSTS OF MARKETING POTATOES OBTAINED.

Representatives of the division visited the Maine shipping area and collected detailed figures from such organizations as had records suitable for the purpose. In all, dealers were covered who handled about 20 per cent of the Maine crop. Probably the most difficult thing encountered was to secure data on the quantity of potatoes handled and the general economic environment of the organizations. Information secured covers the crop years 1920–21 and 1921–22. The material has been tabulated and a preliminary mimeographed pamphlet of tentative results has been published. The final manuscript is being prepared. A similar study has been made covering the costs of marketing Minnesota potatoes.

### MARKETING NORTHWESTERN BOXED APPLES STUDIED.

Data were collected from some of the largest shipping organizations in the Washington apple area. Attention was given to the outline of costs, to assignment of the reasons for variations in cost, and to securing the background of the picture into which the cost data must fall. Data were secured which will point out interesting and helpful lessons in the marketing of the northwest apple crop, particularly the wisdom of some of the practices of that section with respect to storage at eastern or western points, the penalty incurred for failure to get particular varieties on the market when they are in prime condition, and some of the reasons for failure. This material will be prepared for publication promptly.

### COSTS OF MARKETING KANSAS WHEAT.

Examination was made of the records of 66 elevators in north-central Kansas in cooperation with the Kansas State College. Every effort was made to secure such complete information that it will be possible to point out some of the principles on which the efficiency of elevator operation is based and to develop the informa-

tion relative to the efficiency of various methods of purchase and sale. The material is almost tabulated and the preliminary release about ready for publication.

#### ANALYSIS OF COTTON MARGINS.

Collection of data which will enable us to compute and analyze the margins received by various functionaries in the marketing of cotton and cotton cloths is now under way with the cooperation of the Division of Cotton Marketing. The field work has been completed and a preliminary publication is about ready for release. This publication will discuss the margins of the various agencies for the period beginning 1915 and ending in 1922. A great deal of interest has been manifested in this forthcoming report, and a large number of inquiries have been received concerning it. Additional margin studies which are now in progress will be continued. Included in these is the margin study in connection with the operation of Center Market, Washington, D. C.

#### TERMINAL MARKET CONDITIONS AFFECT COSTS OF MARKETING.

Probably the most important work undertaken by the division during the year is the study of marketing fruits and vegetables in New York City, with special reference to the factors which control the costs of distribution. One mimeographed report has been issued, entitled Terminal Conditions in New York as They Affect the Costs of Marketing Fruits and Vegetables. It is planned to publish further information on this subject in the near future. These studies are conducted in cooperation with the Port of New York Authority.

### ADMINISTRATION OF CENTER MARKET.

C. W. Kitchen, *Superintendent.*

Administration, C. H. Walleigh; Mechanical Section, C. R. Mullen; Cold Storage, W. J. Capner; and Inspection, L. A. Delwig and G. A. Anthony.

Operation of Center Market was undertaken by the department on April 1, 1922, pursuant to an act of Congress approved March 4, 1921. The appraisal commission appointed by the President under the provisions of this act filed its award on March 31, 1922, in the amount of $960,250, covering the purchase of the buildings and improvements at Center Market which had been made at the expense of the Washington Market Co. Upon the date of filing the award, 75 per cent of the amount was paid to the Washington Market Co. and 25 per cent held, with interest at the rate of 5 per cent per annum until paid, pending settlement of an appeal which was immediately noted by the company. Briefs have been prepared and filed by both sides with the Court of Appeals of the District of Columbia, but the case has not yet been heard. Information obtained from the Department of Justice indicates that the case will be set for hearing some time in October of this year.

#### COLD-STORAGE WAREHOUSE AND REFRIGERATION SERVICE.

Refrigeration is furnished by the Center Market power plant for approximately 600,000 cubic feet of space. Slightly more than

300,000 cubic feet of this space is used as a public cold-storage warehouse in Center Market, while the remainder is private space. The cold-storage warehouse is operated on a commercial basis, with the single exception that loans of public funds are not made on goods accepted for storage and held as collateral, as is done by most commercial warehouses. In some instances, particularly in connection with such products as apples, this restriction has made it difficult to meet competition. The difficulty is partially overcome by issuing negotiable warehouse receipts, which can be used as collateral for loans from the banks.

Business of the cold-storage warehouse during the past year has been normal. While new accounts are sought wherever obtainable, the Center Market cold storage is intended and operated primarily for the convenience of Center Market dealers and supply firms serving dealers in the market and surrounding market district. Because of the factor of advantageous location, the competition in Washington has not been felt as keenly as might be expected.

Practically all classes of food products placed in cold storage are handled at the warehouse. Much of the business is in small lots, which adds to the cost of handling and increases the liability of error in delivery. More than 9,000 warehouse receipts, covering more than 7,000,000 pounds of foodstuffs, were issued during the past year. The amount of work and care involved in handling an extensive small-lot business is evidenced by the fact that more than 20,700 delivery tickets were issued during the year covering goods delivered from storage. Despite the increased liability for error in handling rather extensive small-lot business as compared to carlot business, our claims for loss and damage during the past year were almost negligible.

### FEW CHANGES IN MARKET TENANTS.

Regulations promulgated by the Secretary when this property was taken over were revised during the past year in some particulars and published in printed form. Generally speaking, the regulations have been adequate to meet the various situations that have arisen. While some rather persistent violations of the regulations, mostly minor in character, have been encountered, their enforcement has been accomplished with a minimum of opposition. The spirit of cooperation manifested by the majority of the lessees in the observance and enforcement of rules has been very gratifying. Little dissatisfaction with Government operation and methods is apparent. No difficulty has been experienced in keeping stands continuously occupied. Only eight changes in tenants occurred during the year. There are at present in our files 102 applications for stands inside the market and 87 applications for farmers' spaces on the north side of B Street set aside for the use of farmers.

### PUBLIC HEALTH GUARDED BY STRICT INSPECTION.

Promulgation of regulations covering the inspection of meats, to protect the public against the sale of impure or unwholesome meats in Center Market, and the employment of a meat inspector to enforce these rules, have been beneficial. In a few instances it has been necessary to condemn meat as unfit for food and order its immediate

removal from the market, but the fact that an inspector is on duty in the market tends to minimize the necessity for such action. The successful dealer recognizes the importance of satisfied customers and strives for quality in service and products.

### IMPROVEMENT IN SANITARY CONDITIONS.

The inspectors are constantly working with the dealers to improve sanitary conditions. Improvement in that direction is apparent and has had a tendency to increase confidence on the part of the public in the market. The enforcement of regulations, particularly with reference to sanitation, is carried on with the hearty cooperation of the dealers.

### PARKING ACCOMMODATIONS IMPROVED.

Careful consideration was given to the problem of providing additional parking space for the automobiles of market patrons early in the past year. The situation was particularly discouraging to patrons on Saturdays, when streets in this area were badly congested. Through the cooperation of the District Commissioners, a police regulation was put into effect limiting the parking of passenger-carrying vehicles around the market to one hour. This regulation has produced good results and added materially to the convenience of the public in trading at Center Market.

### BUSINESS IMPROVED THROUGH ADVERTISING.

A three months' campaign of institutional advertising was conducted during March, April, and May of this year in an effort to increase business in the market and to acquaint the public with the facilities available at Center Market. Advertisements were placed in the four largest newspapers in Washington, space being divided equally among them. While it is difficult to measure the results obtained from such advertising, it is believed that it produced good results and warrants continuation, perhaps in modified form. The cost of the advertising was met entirely by the dealers, this office aiding in furnishing material for use in the preparation of copy. A fund of approximately $2,800 was raised for this purpose by about 125 of the 173 dealers.

### RETAIL MARGINS STUDIED.

Retail prices are collected weekly on several classes of products from a selected list of dealers in cooperation with the Cost of Marketing Division of this bureau. These prices are used in a study of retail margins in conjunction with similar studies in progress in other cities. In connection with the cost of retailing studies, statements of business done in Center Market during the calendar year 1922 were required from all tenants. These statements show gross sales, cost, and expense. The reports are of general value in the operation of the market in addition to their value in connection with cost studies, although their value in the first year is somewhat impaired by the inadequate records kept by some of the smaller dealers.

The rendition of these annual statements is a permanent part of our program, and all dealers were warned at the beginning of the

present calendar year of the importance of keeping adequate records of their business transactions in Center Market. Inadequate cost records are believed to contribute largely to the hazards of retailing, and it is felt that this requirement will be helpful to the dealers in addition to furnishing useful data to the department.

As an indication of the importance of Center Market in the distribution of foodstuffs in this city, these reports show that gross sales, wholesale and retail, during the calendar year 1922 aggregated $14,594,984. This amount does not include sales made by approximately 200 farmers using spaces on the farmers' line. No record of their sales is obtainable.

#### MODERN EQUIPMENT REPLACING OBSOLETE STANDS.

Nine stands were remodeled at a cost of approximately $5,000 during the past year. A fish stand and bottled-goods stand were constructed, and a wholesale meat stand enlarged and remodeled. Four bakery stands, modern in every respect, and requiring the display of bakery products under glass, were recently completed. Replacement of depreciated and obsolete market stands with modern equipment will probably form the chief item of expense in the permanent improvements at Center Market in the next few years. It is planned to install this much needed equipment as rapidly as earnings warrant expenditures.

#### MAKES FAIR RETURN ON INVESTMENT.

From a financial viewpoint, the operation of the market has been successful and a fair return upon the investment has been returned to the Federal Treasury.

### DIVISION OF AGRICULTURAL FINANCE.

V. N. Valgren, *In Charge.*

Rural Private Finance, G. F. Cadisch; Rural Public Finance, C. O. Brannen; Rural Public Utilities, H. S. Beardsley.

#### AID IN FORMULATING CREDIT LEGISLATION.

Information and assistance was given to Congress during the year in formulating and promoting the agricultural credit legislative program which resulted in the agricultural credits act of 1923. This act, based on very wide study, is of great benefit to farmers, as it makes available personal credit at reasonable costs and for periods of time needed to cover the relatively slow turnover of crop and livestock production.

#### AID IN IMPROVING STATE RURAL CREDIT LAWS.

General studies of agricultural credit and insurance have been made in South Carolina in cooperation with Clemson College. In connection with this work practical assistance has been given in improving rural credit conditions in the State by proper amendment of the laws, and the organization of additional farmers' fire insurance companies in counties where none had hitherto existed. Similar work has been carried on in a number of other States.

#### MUTUAL FIRE INSURANCE COMPANIES ENCOURAGED.

Summarizing of State insurance reports for farmers' mutual fire insurance companies was continued in order to have on hand up-to-date information concerning the growth and achievement of this class of insurance institutions in the various States. Press releases on this subject have been issued from time to time to encourage the extension of this practical and economical form of insurance in States where it is as yet largely or entirely lacking and with a view to encouraging improvement in methods and plans of existing companies. Information on this subject has also been extended through correspondence and a few public addresses.

#### CROP INSURANCE INVESTIGATED.

Assistance was given to the Senate Committee on Crop Insurance in arriving at sources of information and also by direct contributions to the hearings of the committee. An extended article on the subject of crop insurance was contributed to the October and November issues of the Journal of Insurance and Financial Statistics. Addresses on the problem of crop insurance were delivered before the National Association of Mutual Insurance Companies at Atlantic City, before the State Association of Mutual Insurance Companies of Indiana, at Indianapolis, and before the graduate students and members of the faculty at Cornell University.

#### TAXATION OF FARMERS' REAL ESTATE STUDIES.

Taxation of farm real estate involving taxes levied, capital value, assessed value, gross and net income from land, and the changes in these various factors over a series of years form the subject of a study begun during the year. Material for this study was obtained in part from county records and in part through a questionnaire to owners of cash rented farms, as this class of farms offers a peculiar opportunity to obtain gross and net income from the ownership of land.

### DIVISION OF AGRICULTURAL COOPERATION.

LLOYD S. TENNY, *Assistant Chief, in Charge.*

Economics of Cooperation, A. W. McKay; Statistics of Cooperation, R. H. Elsworth.

Three projects, namely, (1) economics of cooperation, (2) legal phases of cooperation, and (3) statistics and history of cooperation, have formed the work of the Division of Agricultural Cooperation during the fiscal year.

#### ECONOMIC PHASES OF COOPERATION STUDIED.

Five technical employees, with headquarters in the Washington office, have studied the economic phases of cooperation and rendered service to members and officers of associations, or projected associations, for the greater part of the fiscal year.

Work undertaken by this project included a comprehensive study of the California Fruit Growers' Exchange. Results of this study

are now in manuscript form and will be issued as two bulletins of the department. The first treats of the organization of the exchange, describing the structure of the organization, as a whole, with a brief description of the functions of the component parts. It discusses the development of the system, the marketing difficulties that led to organization, and the economic factors that have affected the development of the exchange during the past 30 years. The second bulletin will cover the operating methods of the exchange, and includes considerable data regarding the expenses of packing and marketing oranges and lemons through the exchange agencies.

### CAUSES OF FAILURE IN COOPERATION DETERMINED.

An investigation of the causes of failure of cooperative marketing associations was begun during the year. Data assembled include replies to questionnaires sent to officers and members of defunct organizations, information secured by correspondence and by detailed personal studies, and analysis of the records of the more important organizations.

At the same time less comprehensive studies have been made, in so far as funds and men available permitted, of the cooperative movement in various sections and for the marketing of various commodities. A survey was made of the operations of the Dark Tobacco Association at Hopkinsville, Ky.; of the Dairymen's League Cooperative Association, Utica, N. Y.; the New England Milk Producers; and other organizations.

### ASSISTANCE GIVEN IN ORGANIZING ASSOCIATIONS.

Service has been given to producers, State bureaus of markets, and State extension officials in connection with the organization of cooperative associations. Information was furnished such persons constantly throughout the year by correspondence and by conferences in the Washington office. At the request of the Minnesota Cooperative Creameries (Inc.), two investigators met the board of directors in a conference in Minneapolis and offered suggestions, based on a study of the association's problems regarding its reorganization and marketing problems. Personal visits were made, on request, to discuss the organization of a vegetable association in Florida and a farmers' county exchange in Georgia. Further assistance was also given the Vermont Maple Products Cooperative Exchange, which had organized in accordance with the recommendations of the division.

### COOPERATION IN FOREIGN COUNTRIES STUDIED.

Studies have been made of cooperation in foreign countries. The division has increased the number of its foreign correspondents during the past year and has amplified considerably the statistical material available regarding the status of the cooperative movement abroad.

Up to December 1 an investigator of the division was in Denmark and other Scandinavian countries studying the cooperative movement in agriculture in those nations. Most attention was paid to cooperation in Denmark, and the result of this study will be made available in a bulletin. The economic conditions which led to the extensive organization for cooperative marketing, the underlying

conditions of rural life and education which have strengthened the cooperative movement, the extent of the movement, and its influence on Danish agriculture are presented in detail.

A somewhat similar study has been made of Russian cooperation from original source material. Statistical data regarding agricultural producer and consumer cooperation up to the beginning of the Bolshevik régime can be secured in considerable detail from published reports, and material regarding the more recent movement is more fragmentary and must be gathered from a number of sources. A great deal has been obtained by correspondence with the large Russian cooperative societies. Since it has been released from Soviet restraints, the cooperative movement in Russia has developed rapidly. Especially along the lines of cooperation for credit, the experience of the Russian cooperators is of value to the movement in this country. The report on Russian cooperation will be in final form shortly.

### LEGAL PHASES OF COOPERATION.

Department Bulletin 1106, entitled Legal Phases of Cooperative Associations, appeared last October. This bulletin discusses the legal problems which arise in the organization and incorporation of cooperative associations. An exhaustive search was made of court records for decisions with a bearing on the activities of cooperative associations, and the references given are the most extensive to be found on the subject. The large demand for the bulletin made it necessary to issue a reprint six months later.

### STATISTICS AND HISTORY OF COOPERATION.

Names of 30,000 farmers' associations were received from 60,000 crop reporters during the year. Each name submitted was given careful consideration, and, if of a functioning organization, an effort made to get a report regarding its recent activities. Extension workers, county agents, postmasters, and business men in the State or locality were called upon for definite information when an association failed to respond to a series of questionnaires, or when mail addressed to the organization was returned unclaimed. A complete list, it is estimated, will contain information regarding about 10,000 organizations. The associations are being classified according to farm products handled, type of enterprise (as shipping association, packing-house company, processing plant, distributing company, etc.), State and city in which located, and the activities of the association regarding collective purchasing. On April 1, 5,000 names and addresses of farmers' business organizations were issued in mimeograph form for the use of those interested in agricultural cooperation.

Reports received continuously from farmers' business organizations in this and foreign countries were studied, classified, and arranged so as to be available for those directly concerned with the development of farmers' organizations. The information obtained was classified as to associations, as to commodities handled, as to types of enterprise created, etc. Classified lists and geographic lists of the associations reporting have been compiled. Much of the information has been punched on tabulating cards that it may be available for intensive studies. A classified addressograph list of

the associations reporting has also been compiled and is frequently used.

DIRECT REPORTS FROM COOPERATIVES.

The collection of special statistics relating to the associations marketing dairy products, and poultry and poultry products, was undertaken in cooperation with the commodity division of the bureau. Special statistics regarding fruit and vegetable cooperative marketing organizations were also secured and will be compiled for the use of the project on the economics of cooperation. The original reports from thousands of associations have been arranged as the basis of a source library on agricultural cooperation.

Definite statistical and historical information regarding cooperation has been given to other Government organizations, to teachers in universities and colleges giving courses in marketing; graduate students preparing theses bearing upon cooperation: State extension workers preparing bulletins, circulars, lectures, etc., for field use; officers and employees of State divisions of markets; editors of farm journals and writers of agricultural articles; officers of farmers' organizations; bankers; chambers of commerce; officers of women's clubs; rural teachers, ministers, and farmers. This service has been rendered in connection with visits made to the bureau, in response to mail requests, and by means of mimeographed circulars and newspaper releases.

A mimeographed circular, Agricultural Cooperation, has been issued semimonthly since January, 1923. The circular contains information regarding the current activities of farmers' associations in more than 40 States. It is sent in response to specific requests from more than 500 bankers, association managers, extension workers, and economists.

## DIVISION OF LAND ECONOMICS.

Dr. L. C. Gray, *In Charge.*

Land Resources and Utilization, O. E. Baker; Land Reclamation, Sale, and Settlement, R. P. Teele; Land Tenure, C. L. Stewart; Land Values, C. R. Chambers; Farm Labor, J. C. Folsom; and Negroes and the Land, W. S. Scarborough.

NATIONAL LAND POLICY PLANNED.

Establishment of a national land policy has been the objective of many general activities on the part of the department, and to these activities the Division of Land Economics has contributed a large share. The economist in charge of this division has been chairman of the department committee on land utilization which has been considering the probable future land needs of the United States and a general classification of the land of the United States with reference to its adaptability to meet those needs, to serve as a basis for formulation of land policies for the future. A preliminary report has been prepared and a summary will appear in the 1923 Yearbook.

GREAT PLAINS AND SPRING-WHEAT REGIONS SURVEYED.

Surveys in the Great Plains and spring-wheat regions have included both the physical and the economic conditions. The physical surveys have been made mostly by the Soil Survey, Weather Bureau,

Bureau of Plant Industry, and Land Classification Board of the United States Geological Survey, Department of the Interior, the Division of Land Economics serving as coordinating agency. The economic surveys have been carried on in North and South Dakota, Montana, Colorado, and Kansas jointly by this division and the Division of Farm Organization of this bureau, in cooperation with the agricultural colleges in the States involved. Results will be published in a series of bulletins dealing with the utilization of the land and the agricultural situation in these regions. Problems of farm organization and land utilization in these regions are very serious, particularly those relating to size of farms and system of farming adapted to the variable climatic conditions. The purpose of these surveys is to help in the solution of these problems.

#### TREND OF LAND UTILIZATION STUDIED.

Increasing population and changes in domestic consumption and in European demand are exerting a powerful influence upon the use of the land for crops, pasture, and forest, and upon the selection of crops and systems of farming. Safe advice to farmers must be based on knowledge of these trends. Studies of the trend of land utilization in the United States as affected by increasing population, changes in consumption tastes, and the European situation have been summarized for publication in the 1923 Yearbook of the Department of Agriculture. A preliminary study appeared in the January, 1923, issue of the Geographical Review.

#### CENSUS STATISTICS ON USE OF LAND TABULATED.

Six questions on crop land harvested, crop failure, and idle crop land, pasture land suitable for crops, woodland pasture, and other pasture land were included at our request in the 1920 census schedule. The data obtained are now being tabulated and compiled, by townships, by this division in cooperation with the Census Bureau. They will be published jointly by the Departments of Commerce and Agriculture, and will probably be presented in map form in the Great Plains bulletins referred to above, and in similar publications for other regions. These statistics provide a basis for the study of land utilization in the United States and the possibilities of increasing production.

#### RECLAMATION POLICIES REVIEWED.

A report on land reclamation policies in the United States was undertaken and completed. In this the history of Federal and State policies of the past is reviewed and recommendations as to the future are made. This report should be useful in formulating future governmental policies as to land reclamation.

A report on farm lands available for settlement was completed and published as Farmers' Bulletin 1271. This has proved to be very useful in answering inquiries as to opportunities for settlement.

A report on the buying of farms in undeveloped regions was prepared and submitted for publication as a Farmers' Bulletin. This report points out the advantages and difficulties to be met in undeveloped regions, and should be helpful to those who contemplate purchasing farms in such regions.

A report has been prepared on methods of land settlement on cut-over lands in the Lake States, which is based on earlier field studies of the methods employed by colonization agencies and of the progress of settlers who have gone onto such lands. This will point out practices that have proved successful and those that have failed, and should serve as a guide to prospective settlers in locating under favorable conditions and in avoiding settlement under conditions in which they have little chance of success.

### COST OF ESTABLISHMENT ON RECLAIMED LAND.

During the year work was begun in cooperation with the Bureau of Public Roads on a project for determining the cost of establishing going farms on reclaimed land. The object of this study is to obtain adequate data for determining the feasibility of land reclamation in different sections. Too often judgment in this matter has been based on the assumption that the cost of reclamation is the only capital investment on which returns should be obtained. This work is going forward in the current fiscal year. It involves a study of the methods adopted by land-settlement agencies in placing people on the land, particularly of the extent to which they prepare land for farmers in advance of settlement, and the terms on which lands are sold.

### SUPERVISION OF LAND SETTLEMENT NEEDED.

Much attention has been given to the public control, supervision, and direction of land settlement, both as to existing State activity along this line and as to the field for possible or desirable Federal activity. During the current year a field study of State activity is being undertaken, and a report will be prepared. This should be useful in pointing out the most desirable and most effective systems of State supervision or control and in showing the field for Federal supervision. There is great need of some public supervision that will prevent fraud; and, at the same time, there seems to be need for public direction along right lines.

### INCOMES FROM IRRIGATED FARMS STUDIED.

A special tabulation of the values, cash rents, and mortgages for irrigated and nonirrigated land was made from the farm schedules obtained by the Bureau of the Census in 1920 in connection with the subject of land reclamation and in cooperation with the Colorado Agricultural College. Results of this tabulation will be digested and a report prepared during the current year. This should throw light on the subject of the value of irrigation in sections where it is possible to farm without it.

### OWNERSHIP AND TENANCY OF FARM LAND STUDIED.

To throw light on methods of renting farms in dairy regions, in July, 1922, Farmers' Bulletin No. 1272, Renting Dairy Farms was issued. A report on the changes in farm occupancy, ownership, and tenancy occurring during the year ending December 1, 1922, was issued in April, 1923. The press story of this report and the companion report entitled When Do Farm Tenants Move? were widely reprinted. Field studies of certain special ownership and tenancy

problems were made in North Carolina in cooperation with the Division of Farm Population and Rural Life and the State Experiment Station, and a similar study was made in Kansas in cooperation with the Kansas State Experiment Station. Some of the results of previous studies of farm ownership and tenancy have been summarized, illustrated by graphs, and will be published as an article in the Yearbook for 1923.

Studies of the progress of negro land owners made in previous years was continued during the last year, and a report on this subject was begun. This should help to determine when success is most likely in the progress of negroes to land ownership.

#### RELATION OF LAND INCOME TO LAND VALUATION STUDIED.

The work on land valuation for the past fiscal year consisted in the preparation of a bulletin entitled Relation of Land Income to Land Value, and in the collection of further data from county records and from farmers. It is a statistical study of the rate of return on investments in farm lands. It should be of considerable value in framing rural-credit policies and developing land appraisal.

New research projects in land valuation begun last year consisted of two surveys to measure the effect of different factors on land value, such as yield per acre, distance to market, road type, etc. One of these surveys was completed in Indiana last November and the tabulation of this material is now nearing completion. The other was begun in Iowa last April in cooperation with the Bureau of Public Roads and the Iowa Agricultural College. Data from these surveys are to be used in connection with all other available data to work out a scientific method of land appraisal and in determining the influence on land values of various types of roads.

This division has also been collecting data on the trend of land values in order to study the effect on land values of changes in the prices of farm products, rates of interest, improvements, etc.

#### CONDITIONS OF FARM LABOR EMPLOYMENT.

A survey of truck-farm labor was made in New Jersey by a field party in the summer of 1922. Practically 1,100 schedules were collected, mostly by canvass, a few by mail. Most of the tabulation of this material has been completed and the manuscript is under way.

### DIVISION OF STATISTICAL AND HISTORICAL RESEARCH.

Dr. O. C. Stine, *Acting, in Charge.*

Foreign Competition and Demand, L. G. Michael.
Production Statistics, Perry Elliott; Marketing Statistics, L. B. Flohr; Agricultural History, N. A. Olsen; Transportation, J. G. Cross; Graphics, G. C. Haas.
G. B. L. Arner, Consulting Statistician.

The main objective of this division is the assembling of statistics and facts on the domestic and foreign production and stocks of the agricultural commodities, the trend of production, imports and exports movements, and other data relative to the domestic demand and prices. The data laid before the committee on agricultural outlook

were assembled by the division and special graphic charts prepared to aid in analyzing the data.

A large part of the statistical section of the Yearbook was prepared in this division. Receipts, shipments, cold-storage holdings, market prices, foreign production, international trade, and foreign prices were included. Contributions were made to the text of the Yearbook articles on trends of production, yields and prices, shifts in production, and foreign competition and demand. All charts and graphs were prepared in the graphics and statistical analysis section of the division.

#### FOREIGN COMPETITION AND DEMAND STUDIED.

Work in the field of foreign competition and demand has been strengthened by extending and improving the foreign crop and market reporting service, by adding men in the Washington office to analyze and interpret the information received, and by adding to and improving the means of disseminating the information received and the results of the analysis and interpretation.

#### BEGIN WORLD CROP AND MARKET SERVICE.

The exchange with foreign countries and with the International Institute of Agriculture at Rome of telegraphic information on crop conditions, estimates, and forecasts has been maintained and the service greatly improved. Arrangements have been made with the naval radio service to transmit reports from Rome, Berlin, and London without expense except the cost of commercial wire connections. To economize further on cable and radio service the Bentley code and the cable address "Agrecon" have been adopted.

Canada, India, Norway, and our agricultural commissioners in London and Berlin send information direct by cable or radio. The International Institute sends bimonthly radiograms on crop conditions in different countries and, as soon as received, crop and livestock estimates and forecasts of each of the foreign countries which report to the institute. The State Department has cooperated through the Consular Service by making reports on the agricultural situation and market conditions, and plans were started for more extensive cooperation in developing a supplementary reporting system through the Consular Service. The Department of Commerce has cooperated by submitting reports of the trade commissioners, and plans have been made for securing regularly through a commercial attaché reports on the cotton crop of China.

#### REPRESENTATIVES AT LONDON AND BERLIN.

The work of an agricultural commissioner has been continued in London. The function of this office is to investigate the demand for agricultural products, report on market conditions, and assist in the development of markets for American agricultural products in Great Britain, Ireland, Holland, Belgium, and France, and to make agricultural and market surveys and develop plans for special investigations. The office is also charged with making personal contacts with government officials and with heads of large business organizations for the purpose of securing necessary information. Constant contact has been maintained by radio relative to current situations.

During the apple-marketing season the prices of American apples in the most important British markets were cabled weekly. Material bearing on all phases of market conditions, production, and demand has been collected in London and forwarded to Washington at the rate of two large pouches per week throughout the year.

The representative stationed at Berlin has made a special investigation of conditions affecting the market for meat and animal products in middle Europe, in addition to keeping the department in touch with current agricultural and market conditions.

It was possible to maintain the representative in South America for only a part of the year, but if funds permit, a representative will be returned to Beunos Aires during the coming year.

#### CLOSER RELATIONS TO INTERNATIONAL INSTITUTE AT ROME.

A representative spent some time devising ways and means for increasing the value of the work of the institute to the United States Department of Agriculture. He made a study of the crop-reporting methods of all the governments adherent to the International Institute of Agriculture, giving particular attention to the crops covered in their reports, the method by which the data are collected and estimates compiled, the system of reporting crop conditions, and the dates upon which area and production estimates and condition reports are made public. He visited the statistical departments of Austria, Czechoslovakia, Germany, Denmark, and England, where he made personal contacts with those in charge of the offices which compile the crop statistics of those countries and report them to the International Institute of Agriculture. This paves the way for improving statistical methods in order to make international crop statistics more uniform, timely, and comparable.

#### BEGIN WORLD SURVEY OF AGRICULTURE.

A survey of the agriculture of those regions of the world that compete with our agricultural products in the foreign field and of those markets that look to the United States as a source of their supplies of foodstuffs and raw materials was begun during the latter part of the fiscal year 1922.

Completion of the investigation in the Danube Basin, begun in the fiscal year 1922, is the first contribution to the world survey. Results of this survey were published in five mimeographed reports. These reports were later combined and will be used as one section of the world report.

A survey of the agriculture of France, with special reference to the changes caused by the war, was planned. Work was begun on surveys of Denmark, Germany, and Poland. Plans were made for a survey of the fruit-growing regions of the Mediterranean Basin. The representative who was located at Buenos Aires as agricultural commissioner made a survey of the agriculture of Chile and Peru. A preliminary survey was made of agricultural conditions and of agricultural production in Manchuria, and some data were collected relative to the agriculture of China.

#### ANALYSIS OF FOREIGN MARKETS AND PRICES.

Analysis of international trade and prices for all agricultural commodities has been started. International trade practices, tariffs,

and ocean rates are also being studied in relation to the marketing of agricultural products. Several special investigations and reports have been made, including a study of the handling and reporting of export shipments of Canadian wheat to and through the United States, and of corresponding movements of American wheat to and through Canada. The purpose of this study was to explain the statistics of exports and imports as published by the two countries. A beginning has been made in the analysis of the demand for specific products in specific countries in a study of the consumption of wheat in the United Kingdom and Italy, and the competition of other countries in supplying the needs of these countries.

#### FOREIGN CROPS AND MARKETS NEWS WIDELY DISTRIBUTED.

Weekly reports of weather and crop conditions during the critical season are sent to the international institute by naval radio. The current foreign situation is given publicity through press releases and radio several times weekly, and is summarized in Foreign Crops and Markets, and selected materials appear weekly in Weather, Crops, and Markets.

Foreign Crops and Markets, a mimeographed circular, issued weekly since March 1, 1922, contains the latest information available on foreign crops and livestock, international trade in agricultural products, prices of agricultural commodities, farm wages, and statistics on consumption and other economic factors that enter into supply and demand for agricultural commodities in foreign countries. It has been used as a means of making available promptly statistical and other information on foreign competition and demand. About 700 copies are circulated to agricultural economists, the press, farm, and market organizations, agricultural colleges, libraries, and research institutions.

#### STATISTICS ON MOVEMENTS AND MARKET PRICES COMPILED.

In the Market Statistics Section statistical data have been compiled, and a report is being printed covering the movements and market prices, and in the case of a few commodities retail and import prices, of the principal farm products, such as butter, cheese, cotton, eggs, fruits, vegetables, grain, hay, feed, hides and skins, livestock, meats, milk, poultry, seeds, tobacco, and wool. Some work has been done on compiling statistics on canned goods, sugar, drug plants, nuts, and silk.

#### PRICE TRENDS STUDIED.

In a broad way these studies involve study of relation of production to price, measurements of demand in relation to price, trends of prices, and the interrelation of the problems of agriculture and transportation.

To furnish a scientific and objective basis for price forecasting a new project was begun. A large part of the uncertainty attending present forecasts of prices arises from the imperfections of our knowledge of price relationships. Price changes and the series indicating changes in the supply and demand factors are as a rule not synchronous but occur with lags. To determine the degree of these relationships and their lags is the ultimate object of this analysis.

The study will supply for each of the major agricultural products the series of economic data indicating conditions of supply and demand which anticipate or forecast price movements. In addition a quantitative measure of the accuracy of each series as a forecaster and of all the series considered in a combined relationship will be calculated.

The practical purpose of the price-analysis work is to give the farmer the benefit of a scientific analysis of his problem, so that he may be able to make the best estimate possible with the facts available. Considerable progress has been made in the analysis of hog and cotton prices, and the study of feeder-cattle prices has been started. The results which have been obtained so far are very encouraging.

#### DEVELOPING MORE ACCURATE INDEX NUMBERS OF FARM PRICES.

This project involves the development of more accurate index numbers of farm prices, market prices, and freight rates. Subindex series for grains, fruits, vegetables, livestock, livestock products, and miscellaneous products are also being constructed. Satisfactory progress has been made on this project. Work was begun on reconstructing index numbers of farm prices. A tentative selection has been made of commodities and groups of commodities to be used. Weights of monthly marketings have been compiled and some computations have been made.

### DIVISION OF FARM POPULATION AND RURAL LIFE.

Dr. C. J. Galpin, *In Charge.*

Rural Population Statistics, V. B. Larson; Population Aspects of Rural Community Buildings, W. C. Nason; Farmers' Standard of Living, E. L. Kirkpatrick.

#### STANDARDS OF LIVING AMONG FARMERS.

A study of the standards of living among farmers in Livingston County, New York State, is in press as Department Bulletin 1214. Studies are in progress in four other States, Iowa, Kansas, Kentucky, and Ohio. The field work is completed or nearly completed and tabulation commenced. These studies are in cooperation with the Bureau of Home Economics. In cooperation with the Division of Land Economics a tabulation is being completed of the data from 860 families in Kentucky, Tennessee, and Texas. Arrangements have been made with the States Relations Service for schedules from home demonstration agents in various States, which should give reports from 2,000 families without the customary cost of field work to our division.

#### FARM POPULATION STUDIED.

Our study of eight counties will be published by the Bureau of the Census in the form of a monograph on farm population, this monograph to contain also such farm-population material as the census has tabulated. This is expected to reach publication by the end of 1923. The population data of the 1920 census for 34 villages in Maryland, New York, and Pennsylvania have been run into the machine count sheets, and are now ready for final table making. It is

confidently hoped that our contact with the Bureau of the Census will finally result in a decennial volume on farm population in which the tabulation will be by counties for the whole United States.

#### ANALYSIS OF COUNTIES INTO PRIMARY GROUPS.

Five counties in different States have been analyzed. Two of these studies have been published by the State colleges cooperating. The study of Boone County, Mo., is now complete, and has been submitted to the Missouri Experiment Station for bulletin publication.

#### FUNCTION OF FARMERS' TRADE AND SERVICE CENTERS.

Three studies have been under way in Louisiana, Minnesota, and Wisconsin regarding the function of farmers trade and service centers. Two are finished, Louisiana and Minnesota. The Louisiana study is published as a research bulletin of Tulane University under the title "Some Factors in Town and Country Relationships." The Minnesota study has been submitted to the Minnesota Agricultural College for a bulletin under the title "Distribution of Goods in Rural Communities." The Wisconsin study has been extended in scope and will continue during the year 1923–24.

#### STUDY OF RURAL INSTITUTIONS IN A STATE.

Three studies of rural institutions have been in progress during the year in Arkansas, Texas, and Virginia. The study in Arkansas is completed and published as a bulletin of Hendrix College under the title "Rural Life in Arkansas at Its Best."

#### MOVEMENTS OF FARM POPULATION.

A small beginning has been made in Wisconsin in a study of 100 families who moved from the farm to town. The field study has just been completed and tabulation begun. A study in Kansas has been projected in a county which has lost farm population heavily. It is hoped to make during the next two years a major project of the study of movements and migration of population to and from farms. Nothing short of a United States chart of the seasonal, annual, and periodic migratory movements of population to the farm and from the farm, so as to show the regular currents of population in direction and extent, can finally satisfy the requirements of this project.

#### LIVING CONDITIONS OF FARM TENANTS.

The study of 1,000 farm families in North Carolina, in cooperation with the North Carolina governor's commission, has been completed and reached publication, in part, in a University of North Carolina Extension Bulletin, Volume II, No. 6, How Farm Tenants Live. The study of 1,000 farm families in Nebraska has culminated in three bulletins of the agricultural experiment station of the University of Nebraska: Bulletin 180, Reading Matter in Nebraska Farm Homes; Bulletin 186, The Nebraska Farm Family, Some Land-Tenure Phases; Bulletin 191, Nebraska Farm Homes, a Comparison of Some Living Conditions of Owners, Part Owners, and Tenants. The study of 400 farm families in the Sikeston area of Missouri has been completed.

### COUNTRY COMMUNITY CENTERS.

Farmers' Bulletin No. 1325, entitled "Rural Planning, the Social Aspects," was issued in July, 1923, in an edition of 30,000. A manuscript for a second Farmers' Bulletin, entitled "Rural Planning: Recreation Places," has been submitted. A third manuscript, entitled "Rural Planning: The American Farm Village," is in process.

The study of rural community buildings has been completed. Three Farmers' Bulletins have been printed and reprinted and have gone through several editions, aggregating over 200,000 copies.

### AWAKENED INTEREST IN RURAL POPULATION PROBLEMS.

The growing popularity of courses in rural sociology is a good index to the broad national interest in the progress of American rural life as a whole. Six hundred American educational institutions—normal schools, colleges, universities, and theological seminaries—gave severally one or more courses last year on this subject. Forty of the 48 State colleges of agriculture were among the 600. Fifteen of the 40 State colleges employed instructors to teach rural sociology full time. Ten years ago not more than 20 of these 600 institutions gave any course touching on the social or human side of farm life.

This amazingly rapid growth in the demand for instruction in the fundamental aspects of rural society creates a correspondingly urgent demand for facts to teach. This division has aimed to furnish a body of trustworthy facts of a basic character to these institutions for their instruction in rural life, rural institutions, and rural development. This divison has followed the policy of making its studies known to these instructors and supplying them with information. In the absence of any other national agency for research upon the social facts of farm population and rural life, a heavy responsibility rests upon this division to make its basic researches wide enough to meet the demand.

## DIVISION OF INFORMATION.

J. Clyde Marquis, *In Charge.*

Editorial Statistician, S. W. Mendum; Editorial, Miss C. B. Sherman, Miss K. G. Rice; Periodicals, A. B. Genung, Miss C. M. Viehmann, Miss H. L. Bonebrake; Press Service, F. George, Jr.; Radio Market News Service, J. C. Gilbert; Exhibits, B. L. Perkins.

The assembling of related facts bearing on the farmer's market questions, as provided by the work in the various parts of the bureau into concise practical statements of particular value to farmers, has been the main objective of this division during the past year. It has supplied an increasing demand for information bearing on the changing agricultural conditions to the press, agricultural writers and editors, investigators, legislators, and farmers. The effort has been to get facts from widely separate sources which have a bearing on one question and to make this information effective by putting it into clear and concise form.

The new, united bureau has proved the means of establishing a center of information on the economics of agriculture such as has not heretofore been available. The bureau is now generally known

and recognized as such a center, and its bulletins, periodicals, and other publications are meeting with constantly increasing demand. An outstanding evidence is the extent to which business organizations that deal with the farm industry are utilizing the crop and market information provided by the bureau. Leading news-distributing agencies such as the press associations and syndicates are giving more and more attention to economic subjects. Cooperative relations have been cultivated with these organizations until their widespread channels of distribution have been made available for economic material.

### INCREASED USE OF THE PRESS.

Through press releases distributed to daily and weekly newspapers the more timely results of work of the bureau gets its widest distribution. During the past year the volume of material released in this manner has been steadily increased, both in quantity and variety of topics covered. A large number of special articles designed for special localities or branches of farm industry have been prepared and distributed.

Special articles on various phases of the bureau's work have been placed in a large number of weekly and monthly magazines and trade journals, thereby promptly reaching a large number of those most interested. During the year more than 300 news stories and items of economic character ranging from 100 to 2,000 words each have been distributed and have been published in periodicals with aggregate circulation of millions of readers. This material has been reproduced in so many forms that there is no adequate means of measuring the extension of its distribution.

### MARKETGRAM SERVICE EXTENDED.

The daily marketgram has been distributed throughout the year from seven offices on the leased-wire system, which are Washington, New York, Cincinnati, Chicago, Kansas City, Minneapolis, and Omaha. This marketgram is distributed daily over the leased wire and is mimeographed in the several offices and mailed at once to daily and weekly newspapers. Through cooperation with the agencies that distribute plate services to newspapers, this daily summarized market review now reaches over 2,000 weekly newspapers with an aggregate circulation of several millions of readers.

### EXPANSION OF RADIO NEWS SERVICE.

Radio broadcasting as a means of disseminating market information has been given a thorough trial during the past year and has fully demonstrated its value. Through the cooperation of the Navy Department, the high-powered radio stations at Arlington, Va., Great Lakes, Ill., and San Francisco, Calif., have been used in transmitting market information which has reached a large portion of the country.

Secondary broadcasting by radio telephone has been further developed, and now any farmer who has an adequate receiving set may get full market reports from the air in practically every part of the United States. An inquiry among county agents showed that

the number of receiving sets on farms is rapidly approaching a quarter of a million, and that through the distribution of these reports by local schools, farmers' organizations, business houses, etc., our market information is becoming available to a large proportion of our farmers.

### NEW BULLETIN SERIES STARTED.

The regular publication work of the bureau has been marked by two new developments. The first is the beginning of a series of manuscripts, to appear later as commodity bulletins, in each of which the methods of marketing a single commodity are portrayed against a comprehensive background that gives the student the essential facts regarding amount of commodity produced, sources of supply, channels of trade through which it passes, quantity, and place of consumption. At least two of the farmers' bulletins that have appeared this year relating to the marketing of potatoes follow this outline of treatment to a certain extent.

Inauguration of a new series of statistical bulletins constitutes the second development. Several manuscripts of this series were prepared before the close of the fiscal year and one was issued shortly after the end of the year. Each bulletin of this series will give in comprehensive form the essential statistics regarding the commodity or related commodities which it treats. This series will include statistics on cold-storage holdings of certain food products; statistics on horses, mules, and tractors; sheep, lamb, and mutton, and wool; vegetables; seeds; fruits; potatoes; carlot shipments of fruits and vegetables; wheat; tobacco, rye, oats, barley, rice, buckwheat, grain sorghum, and flax; cotton; hay and feed; cattle, calves, beef, veal, hides, and skins; hogs and pork; corn; dairy and poultry products.

Progress has been made toward standardization of practices in both statistical and graphic methods used in publications of the bureau, and increased attention has been given to questions of make-up and distribution.

### WEATHER, CROPS, AND MARKETS EXPANDED.

The weekly periodical, Weather, Crops, and Markets, although a department publication, has been assembled and edited in this division. All of the material used in this publication, excepting that relating to weather and a weekly list of publications of the department, originate in various divisions of the bureau. The volume of this material offered for publication has been steadily increasing, which necessitates a close condensation in order to keep the size of the publication within the limits of funds available for its printing. Early in the year a distinct change in the character of tabulated material was made, giving more emphasis to trends and comparisons than market prices. The typographical arrangement of the publication was modified and several new factors were introduced, such as a review of the market week on the first page and the introduction of articles giving summaries of the agricultural situation with respect to various products.

The several mimeographed reports which appear regularly have been edited in this division and their distribution has been directed to those who appear most interested in the work. The Bureau of

Agricultural Economics News has been extended as a house organ for the personnel to give a complete record of the organization's work, administrative changes, field service activities, and other personnel matters essential to the regular work of the bureau. The weekly report, State and Federal Marketing Activities, has been continued as a means of keeping our workers in the field of marketing thoroughly familiar with progress in the States.

The monthly review, The Agricultural Situation, was issued regularly and distributed to county agents and other workers in the economic field and has aided greatly in spreading the fundamental phases regarding agricultural affairs to extension workers, and extracts from it have been reprinted freely in the general press. This publication has been supplemented by charts and statistical summaries sent out at frequent intervals, as well as copies of reports of primary importance on production, consumption, movement, and prices. Through this office a large volume of information has been furnished to extension workers and leading economists in fields relating to agriculture and to editors which has been used as a basis for much important discussion.

### EXHIBITS AND MOTION PICTURES.

There is a growing demand for exhibits which present the results of work of the department in a form suitable for display at fairs, expositions, farmers' meetings, etc. During the year the exhibit section aided in the preparation of the displays for the National Dairy Show and the International Livestock Exposition as well as special displays for numerous meetings of lesser importance. A large collection of lantern slides has been assembled and furnished to the extension forces. A large quantity of illustrated material in the form of photographs from the bureau files has been distributed to periodicals and book publishers and individuals engaged in general educational work.

During the year one complete motion picture, The Golden Fleece, was completed and released for general showing and scenarios have been prepared for several other motion pictures which are now being made.

The staff of the photographic laboratory has been enlarged to take care of the increased volume of photographic work required by the enlarged bureau. The extensive photographic files of the former Bureau of Markets and Office of Farm Management and Farm Economics were consolidated and a new system of filing introduced to make this material, both old and new, more readily available to all workers.

### MARKET NEWS RESEARCH.

Experimental studies of the effect of various forms of publicity upon consumer demand for farm products were inaugurated during the year. The purpose of this work is to develop methods of measuring the effectiveness of various forms of news distribution as an aid in determining the causes for changes in consumer demand for farm products.

## PUBLICATIONS ISSUED DURING THE FISCAL YEAR 1923.

### Department Bulletins.

No. 1034. Farm Management and Farm Organization in Sumter County, Georgia. 1922.
No. 1068. Farm Management and Tenancy in the Black Prairie of Texas. 1922.
No. 1070. Farm Management in Catawba County, North Carolina. 1922.
No. 1083. Farm and Terminal Market Prices, Wheat, Corn, and Oats. Crop Movement Year 1920–21. 1922.
No. 1086. Shrinkage of Soft Pork under Commercial Conditions. 1922.
No. 1095. Producers' Cooperative Milk Distributing Plants. 1922.
No. 1106. Legal Phases of Cooperative Associations. 1922.
No. 1109. Sales Methods and Policies of a Growers' National Marketing Agency. 1923.
No. 1124. The Marketing of Mill Feeds. 1922.
No. 1135. Spinning Tests of Cotton Compressed to Different Densities. 1923.
No. 1144. Cost of Milk Production on Forty-eight Wisconsin Farms. 1923.
No. 1148. Comparative Spinning Tests of Superior Varieties of Cotton. 1923.

### Farmers' Bulletins.

No. 1245. Farmers' Telephone Companies: Organization, Financing and Management. 1922.
No. 1265. Business Methods for Marketing Hay. 1922.
No. 1271. Farm Lands Available for Settlement. 1922.
No. 1272. Renting Dairy Farms. 1922.
No. 1274. Uses of Rural Community Buildings. 1922.
No. 1287. Foreign Material in Spring Wheat. 1922.
No. 1289. Distribution of Types of Farming in the United States. 1923.
No. 1290. The Bulk Handling of Grain. 1922.
No. 1291. Preparation of Fresh Tomatoes for Market. 1922.
No. 1292. Organization and Management of Cooperative Live Stock Shipping Associations. 1923.
No. 1295. What Tractors and Horses Do on Corn-Belt Farms. 1923.
No. 1296. Changes Effected by Tractors on Corn-Belt Farms. 1923.
No. 1297. Cost of Using Tractors on Corn-Belt Farms. 1923.
No. 1298. Cost of Using Horses on Corn-Belt Farms. 1923.
No. 1299. Shall I Buy a Tractor? 1923.
No. 1300. Choosing a Tractor. 1923.
No. 1308. Marketing the Cowpea Seed Crop. 1923.
No. 1316. Marketing the Early Potato Crop. 1923.
No. 1325. Rural Planning—The Social Aspects. 1923.

### Service and Regulatory Announcements (Agricultural Economics).

No. 71. Complete Lists of Warehousemen, Classifiers, Inspectors, Graders, and Weighers—under the U. S. Warehouse Act. 1922.
No. 72. Establishment and Replacement of the Official Cotton Standards of the U. S. 1922.
No. 73. Official Grain Standards of the U. S. for Rye. 1923.
No. 74. Rules and Regulations of the Secretary of Agriculture for the Management and Control of Center Market. 1923.

### Office of Secretary Circulars.

No. 157. Handbook for Use in the Inspection of Whole-Milk American Cheese under the Food Products Inspection Law. 1923.
No. 158. Regulations for Cotton Warehouses under U. S. Warehouse Act. 1922.
No. 159. Regulations of the Secretary of Agriculture under the U. S. Cotton Futures Act. 1922.
No. 160. Rules and Regulations of the Secretary of Agriculture under the Food Products Inspection Law. 1922.

### Department Circulars.

No. 228. Live Stock Industry in South America. 1922.
No. 236. Defects in the Quality of Butter. 1922.
No. 238. United States Grades for Potatoes. 1922.
No. 245. United States Grades for Grain Sorghums. 1922.
No. 246. United States Grades for Rye. 1922.

### Miscellaneous Circulars.

No. 6. Crop and Live Stock Estimates, 1910–1922. 1923.

### Yearbook Separates.

No. 867. Imports and Exports of Agricultural Products. 1921 Yearbook.
No. 868. Statistics of Grain Crops. 1921 Yearbook.
No. 869. Statistics of Crops other than Grain Crops. 1921 Yearbook.
No. 870. Live Stock. 1921 Yearbook.
No. 871. Miscellaneous Agricultural Statistics. 1921 Yearbook.
No. 872. The Corn Crop. 1921 Yearbook.
No. 873. Wheat Production and Marketing. 1921 Yearbook.
No. 874. Our Beef Supply. 1921 Yearbook.
No. 876. Cost Data for Farm Products. 1921 Yearbook.
No. 877. The Cotton Situation. 1921 Yearbook.
No. 878. A Graphic Summary of American Agriculture. 1921 Yearbook.

### Preliminary Reports Issued During the Year.

The Business Analysis of 100 Truck Farms, Hillsboro County, Florida. October, 1922.
Incomes and Profits of 100 Fruit Farms, Polk County, Florida. August, 1922.
Returns from Farming on 6,094 Farms. June, 1923.
Farming in Northeastern Montana. January, 1923.
Farm Occupancy, Ownership, and Tenancy, 1922. April, 1923.
When do Farm Tenants Move? April, 1923.
Sources of Supply and Conditions of Employment of Harvest Labor in the Wheat Belt. June, 1923.
Conditions Affecting the Demand for Harvest Labor in the Wheat Belt. July, 1923.
Cost of Producing Apples and Farm Business Analysis for 48 Orchard Farms for Five Years. 1916–1920. September, 1922.
Cost of Fattening Cattle in Nebraska. (Winter 1921–22.) 122 Droves—4,222 Cattle. Bureau of Agricultural Economics and Bureau of Animal Industry Cooperating. November, 1922.
Cost of Fattening Cattle in Illinois. (Winter 1921–22.) 106 Droves—4,202 Head. Bureau of Agricultural Economics and Bureau of Animal Industry Cooperating. January, 1923.
Cost of Fattening Cattle in Iowa. (Winter 1921–22.) 117 Droves—4,717 Cattle. Bureau of Agricultural Economics and Bureau of Animal Industry Cooperating. January, 1923.
Cost of Fattening Cattle in Missouri. (Winter 1921–22.) 101 Droves—4,914 Head. Bureau of Agricultural Economics and Bureau of Animal Industry Cooperating. February, 1923.
Cost of Fattening Cattle in Indiana. (Winter 1921–22.) 117 Droves—4,877 Head. Bureau of Agricultural Economics and Bureau of Animal Industry Cooperating. June, 1923.
Cost of Producing Winter Wheat and Incomes from Wheat Farming, Sherman County, Oregon. 1920–21. May, 1923.
Cost of Producing Virginia Dark Fire-Cured and Bright Tobacco. Charlotte and Adjacent Counties Crop Year 1922. Virginia Agricultural College and Polytechnic Institute and Bureau of Agricultural Economics Cooperating. June, 1923.
Bookkeeping Records for Retail Meat Dealers. Northwestern University School of Commerce, Bureau of Business Research and the Bureau of Agricultural Economics Cooperating. 1922.

Cost of Marketing Livestock in the Corn Belt, 1921. Partial results of the tabulation of data collected from 237 Cooperative Livestock Shipping Associations by the Cost of Marketing Division. February, 1923.

Cost of Marketing Cattle in the Corn Belt, 1921. Partial results of the tabulation of data collected from 237 Cooperative Livestock Shipping Associations by the Cost of Marketing Division. March, 1923.

Terminal Conditions at the Port of New York as they affect the Cost of Marketing Fruits and Vegetables. Bureau of Agricultural Economics and the Port of New York Authority, N. Y. City, Cooperating. March, 1923.

Cost of Marketing Sheep in the Corn Belt, 1921. Partial results of the tabulation of data collected from 237 Cooperative Livestock Shipping Associations by the Cost of Marketing Division. April, 1923.

A study of the Retail Meat Trade in Five Wisconsin Cities, 1921. June, 1923.

Cost of Marketing Maine Potatoes by Country Shippers in Aroostock County, Maine. Seasons 1919–20, 1920–21, and 1921–22. June, 1923.

# REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
*Washington, D. C., September 14, 1923.*

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1923.

Respectfully,

J. R. MOHLER,
*Chief of Bureau.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## SOME IMPORTANT FEATURES OF THE YEAR'S WORK.

### MEAT INSPECTION MAKES RECORD.

The Federal meat inspection, during the fiscal year covered by this report, reached the highest mark in its history. The number of animals slaughtered under inspection exceeded 73,000,000, which is more than 2,000,000 greater than the best previous record. The largest increase was in the number of hogs.

### MARKED PROGRESS IN TUBERCULOSIS ERADICATION.

Rapid advances were made in the cooperative campaign to eradicate bovine tuberculosis. An increase of 76 per cent was made in the number of herds of cattle officially accredited as free from tuberculosis. At the close of the fiscal year there were 28,526 such herds, comprising 615,156 cattle, and there were under supervision more than 400,000 herds containing nearly four and a half million cattle. Unfilled applications for testing nearly a million additional cattle were on file.

The plan of eradicating tuberculosis from circumscribed areas, with the county as the unit, has met with marked success. Fifty additional counties were freed during the year, raising the total to 81. Arrangements have been made to accord special facilities for shipping cattle from counties known as "modified accredited areas" without the usual quarantine restrictions. In the course of the year's work the tuberculin test was applied to nearly three and a half million cattle. Those found diseased were slaughtered under inspection as a rule and indemnity was paid to the owners. Larger financial support is being provided by States and counties, and the work is growing in favor with cattle owners.

### PROTECTING LIVESTOCK FROM FOREIGN PLAGUES.

Foot-and-mouth disease has continued its ravages in many parts of the world, and its appearance in Jamaica constitutes a distinct menace to the livestock industry of the United States. The bureau's quarantine forces have been constantly on the alert to prevent its entrance and so far have been successful. Not only are live animals from infected countries excluded, but stringent restrictions are enforced with regard to products that are likely to carry the infection. In view of the constant danger, plans have been carefully laid for the immediate organization of forces and adoption of measures to combat an outbreak if the disease should appear in this country. Printed matter is on hand ready for use, and inspectors have been instructed in their duties.

An example of the danger of the introduction of various infectious diseases from abroad is afforded by the finding of organisms of the kind that cause the destructive disease known as surra in the blood of five dromedaries, offered for importation and inspected at one of the bureau's quarantine stations.

### PRACTICAL BENEFITS FROM SCIENTIFIC RESEARCH.

Results accruing in some of the bureau's research work relative to animal parasites have afforded striking evidence of the practical value of scientific experimentation. The discovery by the bureau that carbon tetrachlorid is an effective remedy in the removal of hookworms of dogs has led to the wholesale application of this treatment against hookworms of human beings in many parts of the world with remarkable success. Investigations regarding roundworms of sheep and swine have made it possible to overcome to a large extent the losses caused by those parasites. Research work on animal diseases and parasites and on various technical problems related to the livestock industry is constantly going forward in the bureau's laboratories and experiment stations.

### LIVESTOCK IMPROVEMENT THROUGH BETTER SIRES.

The continued demand for information and methods on the improvement of livestock or the use of better sires have brought about several developments in the systematic effort to improve domestic animals in the country. This work, which began nearly four years ago under the slogan, "Better Sires—Better Stock," continued to grow and is now a project of considerable size and importance. Reports on its progress are issued quarterly for the information of State officials, county agents, and others cooperating. At the close of the fiscal year 11,533 livestock owners had filed with the department written pledges to the effect that they have placed their farms on a strictly purebred-sire basis and agreed to use good purebred sires exclusively in their breeding operations for all classes of animals kept.

States which have made especially noteworthy progress in the work are, in the order listed, Ohio, Virginia, Nebraska, and Kentucky. The results continue to show that the use of purebred sires has an important influence in stimulating the ownership of purebred female livestock. In fact, more than a third of all female animals kept by purebred-sire users are purebred. The remainder are prin-

cipally grades and crossbreds. Only about 2 per cent of the female animals kept by purebred-sire users were scrubs.

A development of the work which is proving popular is the distribution of a sign bearing the words, "Purebred Sires Exclusively Used on This Farm." The sign is lithographed on cardboard in several colors and resembles a metal tablet.

### MEAT YIELDS OF FOOD ANIMALS.

In connection with the movement for better sires and improving livestock, the bureau made a statistical study showing the meat yields of various classes of animals in proportion to live weight. The figures obtained bring out clearly the importance of good breeding. The grades of livestock studied varied from the common grades of market animals to animals slaughtered in the carcass competition of the International Livestock Exposition. Records from a number of Government sources and from the packing industry were studied.

The difference in dressing yield for various grades of cattle ranged from 48 to 66 per cent, meaning that that proportion of the animal was the dressed carcass. For sheep and lambs the dressing yield varied from 42 per cent for common market ewes to 58.3 per cent for International Show wethers. The figures for swine show dressing percentages ranging from 75 to 85.3 per cent. The relatively high figures for swine are due in part to the fact that the skin and head commonly remain on the carcass. The International Show animals in each case are chiefly purebreds, fed specially to produce an ideal carcass.

The results are clear-cut evidence that the types of animals shown and recognized as best by judges of livestock are much superior to poorly bred stock from a meat standpoint.

### STUDY OF FEEDING PROBLEMS.

As a means of determining and disseminating better methods of livestock feeding, the bureau made a questionnaire study on current livestock problems and how farmers are meeting them. The result showed briefly that in the experience of nearly 500 livestock owners the general economy of rations, the cost of grains, and more specifically the cost of protein, represent more than half of all feeding difficulties. The question of balancing rations is next most important. Livestock of improved breeding were reported in the great majority of cases as making greater gains or producing more than scrubs or common stock when fed in the same way. The average superiority of improved stock in the use of feeds as shown by financial returns was 39.6 per cent over common stock. Other results of the questionnaire deal with a variety of subjects. Silage appears to be used on about one-half of the progressive farms where livestock are raised. Self-feeders are commonly accepted as good equipment in the feeding of hogs and poultry and to some extent with other stock. Feeding dairy cows according to production received widespread approval as a progressive feeding practice. The balancing of rations, more liberal and regular feeding, and the use of legumes are the chief means by which livestock owners are improving feeding methods. The study showed also that the common mistakes in feeding can be corrected by livestock owners themselves, since most of the mistakes are details of care and management.

### PERSONNEL.

At the beginning of the fiscal year there were 4,241 employees in the bureau service. During the year 466 new appointments were made, 26 employees were transferred from other bureaus or departments, and 46 former employees were reinstated, making 538 additions to bureau forces. During the same period 582 employees were separated from the service, 230 by resignation, 24 by death, 25 by transfer to other branches of the Federal service, 7 by removal for cause, and 6 by retirement under the provisions of the act of May 22, 1920, while other separations numbered 290. At the close of the fiscal year the bureau rolls contained 4,197 names, a decrease of 44 for the year.

### VETERINARY EDUCATION.

The number of accredited veterinary colleges whose graduates are eligible to take the civil-service examination for bureau positions decreased by 1 as a result of the discontinuance of the New York State Veterinary College (New York University), leaving 15 accredited colleges at the close of the fiscal year. The graduates of 3 agricultural colleges with two-year veterinary courses are given credit for work completed in these institutions when entering one of the accredited veterinary colleges. The number of foreign veterinary colleges accredited by the bureau remains at 10, as in the preceding year.

The total number of freshmen enrolled in all the accredited veterinary colleges in the United States and in one in Canada for the school year of 1922–23 was 176 as compared with 169 for the preceding year. The total student enrollment was 738 against 796 the year before. Six of the students included in the total enrollment were attending agricultural colleges having a two-year veterinary course and must take additional instruction at accredited colleges before becoming eligible for bureau positions. The number of veterinarians graduated at the close of the school year by the accredited colleges mentioned was 241 as compared with 171 in 1922.

### LITERATURE, EXHIBITS, AND MOTION PICTURES.

During the year the bureau contributed 94 new and revised publications, including 37 farmers' bulletins, 17 department bulletins, 1 paper for the Yearbook, 13 issues of Service and Regulatory Announcements (including index), 1 article for the Journal of Agricultural Research, 6 department circulars, 7 miscellaneous pamphlets, 11 orders in the nature of regulations, and 1 map. In addition the bureau planned and issued 4 new posters. There were prepared for outside publication in scientific, agricultural, and other journals 62 manuscripts, including 10 papers for broadcasting by radio. In addition the bureau furnished to the Press Service of the department 190 articles and items for the information of the public.

In cooperation with the department's Office of Exhibits, the bureau prepared exhibits for numerous agricultural expositions, shows, and fairs. This form of public information has received favorable comment as a means of acquainting the public with bureau activities. Special exhibits for the National Dairy Exposition and the International Livestock Exposition were especially well received.

Several new motion pictures were prepared during the year by the department Motion Picture Office, from scenarios prepared in various bureau offices. "Molly of Pine Grove Vat," telling in story form how a southern community eradicated cattle ticks, has been especially beneficial in preliminary tick-eradication work. "A Tale of Two Bulls," another new film, deals with bull-association activities. "The Horse in Motion" is the title of a popular film showing the gaits of various classes of horses, and is among the most popular in the department's collection. Other new films are in various stages of making.

### REPORTS BY DIVISIONS.

The year's work as conducted by the various divisions of the bureau is presented more fully in the following pages.

## ANIMAL HUSBANDRY DIVISION.

The work of the Animal Husbandry Division, consisting chiefly of research in animal husbandry, including poultry husbandry, was conducted under the direction of E. W. Sheets, acting chief of the division.

Cooperation with other branches of the department and with State agricultural colleges in the study of regional and national problems and in promoting livestock improvement has been developed to a larger extent. The division assisted in the better-sires campaign and in outlining a national plan for the better feeding of farm animals.

### ANIMAL HUSBANDRY EXPERIMENT FARM.

Further improvements were made at the United States Experiment Farm, Beltsville, Md., and at other station farms in different parts of the country. The addition of the nutrition laboratory and the enlarging of the laboratory for meat investigations at Beltsville provide improved facilities for these important lines of work. This farm is used as a practical laboratory and proving ground for solving animal-husbandry problems. The experimental work is reported under other headings.

### ANIMAL GENETICS.

The study of the effects of different systems of mating was continued as the major subject. Experiments on the effects of inbreeding, crossbreeding, and selection were carried on with guinea pigs. The conclusions to date are presented in Department Bulletins 1090 and 1121. The effects to be expected from different systems of mating according to the Mendelian theory of heredity have been worked out and compared with the experimental results. They are in agreement as far as determined. This study has led to a method of comparing the theoretical consequences of the irregular systems of mating found in actual pedigrees with regular systems and with experimental results. A detailed study of the breeding of Bates's Duchess family of Shorthorn cattle has been made by this method, and similar studies with other noted strains of livestock and with samples of the breeds are in progress. The conclusions derived from these studies on the effects of different systems of mating are being applied to inbreeding experiments with hogs and poultry.

Studies of differences in resistance to tuberculosis were continued in cooperation with Dr. Paul A. Lewis, of the Rockefeller Foundation, and similar studies with pneumonia were begun in cooperation with Dr. Reynold Spaeth, of Johns Hopkins University.

Studies of the inheritance of various characteristics of livestock are being conducted by biometric methods.

### BEEF-CATTLE INVESTIGATIONS.

Investigations in the production and fattening of beef cattle were continued in the Appalachian region, the Corn Belt, the Cotton Belt, and the western and southwestern range areas, in cooperation with the respective State agricultural experiment stations. The Bureau of Agricultural Economics of the department also cooperated in the investigations in the Corn Belt and range areas. Results of the work are published from time to time.

#### FATTENING STEERS IN THE CORN BELT.

Investigations in Illinois, Indiana, Iowa, Missouri, and Nebraska to determine the basic requirements in feed, labor, and miscellaneous items in fattening beef cattle, planned to cover a period of five years, are now in their last year. Approximately 100 feeding records have been taken annually in each of the five States. The total yearly survey involves from 18,000 to 20,000 head of beef cattle. The surveys make it possible to compare the methods and economy of production. Data for four years have been compiled for publication.

#### WINTERING STEERS IN THE APPALACHIAN REGION.

At Lewisburg, W. Va., the final year's work in a three-year experiment in wintering 2-year-old steers to determine the effect of winter rations on the gains made upon pasture the following summer was concluded in September, 1922. The results have been prepared for publication.

A new experiment was begun in December to study the growth of weanling calves on various winter rations followed by summer grazing on bluegrass pasture.

#### FEEDING BEEF CATTLE IN THE COTTON BELT.

At the Coastal Plain Experiment Station, McNeill, Miss., a three-year project to study the gains made by cattle on native pastures burned off each winter, has been completed. The results show that when the cattle are grazed at the rate of one head to 10 acres they make satisfactory gains until about the middle of June and then barely maintain their weight until frost. When the rate of grazing was heavier the same rate of gain per animal was obtained for a longer time, because the maturing of the native grasses was retarded.

A new project was begun in March in cooperation with the Forest Service to compare the effects of burning and not burning native pasture on the gains made by the cattle, the kind of grasses which survive, and the extent and kind of reforestation which takes place.

At Jonesboro, Ark., an experiment was conducted to compare certain rations as winter feeds for beef cows. Work has been continued to determine the quantities of feed required to produce beef cattle of breeding age.

At Jeanerette, La., experiments in feeding steers were carried on during the winter to compare certain silage mixtures. The experiment comparing the progeny of Brahman (Zebu) and Hereford bulls when bred to grade cows is being continued.

#### FEEDING FOR MILKING QUALITY IN BEEF CATTLE.

The 20-year experiment begun September 1, 1915, at Manhattan, Kans., in cooperation with the State agricultural college, to determine to what extent milk production can be developed without sacrificing desirable beef type, is being continued with a breeding herd of Shorthorn cattle.

#### BEEF PRODUCTION ON THE RANGE.

Surveys similar to those made in the Corn Belt are being made to determine the basic requirements in feed, labor, and miscellaneous items involved in the growing and raising of beef cattle in the western and southwestern range States. Work is well under way in Colorado and Texas. Grazing experiments with beef steers are under way at Ardmore, S. Dak., and Mandan, N. Dak., to determine the carrying capacity of the range in those sections.

Different phases of beef production under range conditions are being studied at Ardmore, S. Dak., Havre, Mont., Tucumcari, N. Mex., and Big Spring, Tex. These studies include work with cows, calves, and yearling and 2-year-old steers.

### SWINE INVESTIGATIONS.

Swine investigations have been conducted at the Beltsville (Md.) farm and at several field stations and State agricultural experiment stations.

#### SOFT-PORK INVESTIGATIONS.

Further study of the soft-pork problem led to a better understanding of the causes and nature of the trouble. Experiments involving 372 hogs were carried on in cooperation with the State stations of Alabama, Arkansas, Georgia, Indiana, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and Texas, besides 6 hogs from a North Carolina farm; also independent experiments with 217 hogs were carried on at bureau farms, making a total of 595 hogs used in these investigations. Since the beginning of the work, in 1919, a total of 1,958 hogs has been used. During the last year the experimental hogs were fed on peanuts, peanut meal, soybeans, velvet beans, rice by-products, mast, chufas, and combinations including some of these and other feeds.

As a part of the soft-pork studies, tests were made to determine the relative shrinkage and dressing percentages of firm and soft hogs. The work also included studies of the equality of products from hogs of different degrees of firmness, both in the fresh state and when cured by different methods.

Four hundred and eighty-seven of the hogs were slaughtered at the abattoir on the Beltsville farm, 90 at a commercial plant at Oklahoma, Okla., and 18 at a commercial plant at Atlanta, Ga. All carcasses and products were graded by a committee of three experts, and chemical tests were made of fat samples.

The conclusions reached from the work done up to that time were formulated as follows by a conference of representatives of the agencies cooperating in the soft-pork investigations held at Atlanta, Ga., in April, 1923:

Three years of continued investigation of the soft-pork problem by the North Carolina, Georgia, Mississippi, and South Carolina experiment stations in cooperation with the United States Department of Agriculture showed that when hogs started at a weight of approximately 100 pounds were fed on peanuts for a period of 60 days a soft carcass was produced, and that it was impossible to produce a hard carcass by feeding corn and tankage or corn and cottonseed meal to these soft hogs for a subsequent period of 60 days.

Since the four years' work has been summarized the results show that 100-pound pigs softened on peanuts during a period of 60 days are made firmer by subsequent feeding of hardening feed. However, it is yet impossible from these data to recommend a practical method of producing a strictly hard carcass from such hogs.

### SLAUGHTER AND CURING TESTS.

As most of the experimental hogs in the soft-pork and other investigations finally reach the Beltsville abattoir for slaughter, a considerable volume of meat is handled in the course of the year and opportunity is afforded for making slaughter and curing tests and collecting data.

Slaughtering was done on 32 separate dates, and 623 hogs were killed. The average live weight of these hogs was 187 pounds. Their average cold dressing percentage, reckoned with head and ham facings on, leaf fat and kidneys in, was 79.95 per cent. Data have been obtained on the dressing percentage, chilling shrinkage, and cutting yields for different weights and classes of hogs, on the proportions of bone, skin, and offal obtained in slaughtering operations, on rendering yields of fat, and on the effects of different methods of curing and smoking on the quality and weight of pork cuts.

The sale of meats belonging to the Government yielded $7,586.02. Receipts from the sale of carcasses from the cooperating stations were paid to the respective stations.

### OTHER WORK RELATING TO SWINE.

In cooperation with the Agricultural Engineering Division of the Bureau of Public Roads special studies have been made in the design and construction of self-feeders.

Experiments to determine the effect of lice and worms on the fattening properties of hogs are being continued, in cooperation with the Zoological Division.

Studies of the possibilities of serum-virus immunization of suckling pigs against cholera are being made in cooperation with the Biochemic Division.

## SHEEP AND GOAT INVESTIGATIONS.

### FARM-SHEEP INVESTIGATIONS.

Farm-sheep investigations were continued at the bureau's experiment farm at Beltsville, Md., and at the United States Morgan Horse Farm, Middlebury, Vt.

The main lines of work at Beltsville are (1) development of a practical system of forage-crop pastures for sheep, (2) effects of flushing (extra feed) at the time of conception on lamb yields, (3) growth studies, and (4) type fixing of purebred sheep.

The forage-crop studies have demonstrated that sheep can be grown successfully by using these crops to provide the entire summer pasture; that by a system of rotation of forage-crop pastures lambs can be grown to market age without loss of vitality or depreciation of gains; and that the frequent change of pastures made possible by this system is beneficial but not entirely adequate in the control of parasites in sheep carried throughout the year.

The fixing of type of the purebred Southdown, Hampshire, and Shropshire sheep was continued by selective breeding. At the close of the fiscal year the Beltsville flocks comprised 159 Southdowns, 66 Shropshires, 62 Hampshires, and 13 Corriedales, a total of 300 sheep.

The investigations at Middlebury related to (1) the effects of flushing at breeding time on lamb yields, (2) growth studies, (3) grading up farm sheep, and (4) early as compared with late lamb production. The flushing experiments showed an advantage in favor of flushing. Grading up was continued by crossing the western ewes and their offspring with purebred Shropshire and Southdown rams and selecting the ewe lambs on points of type, conformation, and fleece desirable for farm sheep. The early and late lambing experiment for the third successive year showed the economy of late lamb production. Lambs dropped in May and June and marketed in November yielded a net average of $4.38 a head more than those dropped in February and March and marketed in July.

At both Beltsville and Middlebury data on the growth of lambs are kept through weekly weighings.

### RANGE-SHEEP INVESTIGATIONS.

Studies of important range-sheep problems are under way at the United States Sheep Experiment Station, Dubois, Idaho, where there are 3,745 sheep and lambs of the Rambouillet, Corriedale, and Columbia breeds and crosses. This work includes (1) the breeding and improvement of types of sheep adapted to the range, (2) comparative value of lamb and wool yields from different types of range sheep, (3) watering sheep on the range from wells and reservoirs, (4) shed lambing, (5) wintering range sheep, and (6) range improvement through grazing and reseeding methods, in cooperation with the Forest Service.

The breeding and grazing work at Dubois is serving as a means of determining the type of sheep that, when grazed on a particular type of range, yield the greatest returns in mutton and wool. The production of both mutton and wool is studied in great detail.

A vast area of the western range is not available for sheep grazing because of lack of water for livestock. The watering experiments at Dubois involve the use of water from a well 750 feet deep, excess flood water in open reservoirs, and water from snowdrifts protected to prevent rapid melting. The well is the most dependable, though the other two methods afford means of providing water cheaply for a short time during the early spring grazing season. The daily water requirements during dry weather have varied from approximately two-thirds to three-fourths of a gallon a head.

Ten paddocks and large fenced areas comprising about 4,000 acres and several thousand acres of open range are being used for the grazing investigation, which has not progressed far enough to yield definite results.

#### WOOL STUDIES.

The fleeces produced by the experimental sheep used in the farm and range projects are scored for weight, fineness of fiber, length of staple, character, density, and distribution of fleece over the back. The results of three years' work show that the sides of the fleeces are more representative of the entire fleece than any of the other parts as an indication of the grease, dirt, and clean wool content. Methods of this work are presented in Department Bulletin 1100.

#### MILK-GOAT INVESTIGATIONS.

Continued improvement of the bureau's herd of milk goats at the Beltsville farm since 1911 has resulted from the breeding up of common American does by means of purebred Swiss Toggenburg and Saanen sires of heavy milking strains. The herd contains 40 goats, including 2 purebred Swiss bucks. Records of breeding, feeding, and milk production, and reports on the use of goats' milk for infants and invalids, are kept on file.

### HORSE AND MULE INVESTIGATIONS.

#### BREEDING AMERICAN UTILITY HORSES.

The project for the development of a breed of native American utility horses for general farm and ranch work, conducted in recent years at Buffalo, Wyo., in cooperation with the State of Wyoming, was transferred at the close of the fiscal year to Laramie, Wyo., where it is to be conducted in cooperation with the University of Wyoming. According to terms of agreement 39 animals were selected from the stud to go into the new work. The animals produced have shown continual improvement in uniformity and quality. Several stallions produced in this project stood for public service during the year.

#### BREEDING MORGAN HORSES.

The quality of the animals produced in the project for breeding Morgan horses at the United States Morgan Horse Farm, Middlebury, Vt., has steadily improved. While increased size has not been emphasized, records indicate that there has been a gradual increase in height and weight of the horses produced. Stallions from this project stood for public service throughout New England, and

breeding stock was sent to many parts of the United States and to Porto Rico, Guam, and Japan. The surplus animals produced at the farm do not nearly meet the demand.

The stallion Troubadour of Willowmoor 6459, the premier sire in this stud, continues to be a very satisfactory sire. The stallion Bennington 5693 is being used rather extensively, and the stallion Mansfield 7255, donated by C. C. Stillman, is also being used.

In the annual eastern endurance test held at Fort Ethan Allen, Vt., 21 horses started, of which 2 were purebred Morgans. One of the latter, Gladstone, bred and owned by the department, was placed second.

#### FARM-POWER STUDIES.

The bureau has continued its cooperation with the Agricultural Engineering Division of the Bureau of Public Roads in carrying on at the Beltsville farm specific studies relating to the efficiency of horses as a part of the economic studies conducted by the department to determine the cost and utilization of power on farms in certain areas and to study the effect of the introduction of the tractor on farm-power requirements. The results are reported through the Farm Power Committee in department publications.

#### CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING PURPOSES.

Under provisions of paragraph 1506 of the tariff act of 1922 the bureau issued certificates of pure breeding for 1,156 cattle, 230 horses, 518 sheep, 1,011 dogs, 7 cats, and 69 foxes.

### POULTRY INVESTIGATIONS.

#### POULTRY BREEDING.

The general scope of the poultry-breeding work at the Beltsville farm includes improvement in egg production and the maintenance of typical breed character and standard quality. This combination has been effected more successfully with the Single-Comb White Leghorn and the Rhode Island Red than with any of the other breeds. The improvement noted in the Barred Plymouth Rocks during the last two or three breeding seasons has been fully maintained, and the leading pullet in egg production at this time is of this breed.

At the Baltimore Poultry Show good specimens of these breeds were shown with accompanying egg records, and favorable comment on their appearance was elicited from poultry breeders and the press.

About 1,500 hens were trap nested, of which about 1,200 were pullets and the remainder yearlings and older hens. Egg production was quite satisfactory during the winter months and was well maintained during the spring and summer.

The effort to increase flock production by selective breeding without the use of the trap nest is being continued. Late-molting hens showing other external evidences of good production are used as breeding stock in this work. Their progeny seem to mature early, producing a somewhat larger number of winter eggs, with a corresponding increase in value. The annual production of the daughters of these late-molting hens also shows a slight increase. Further verification of results will be sought in continuing this work.

Selective inbreeding in six brother-and-sister matings of Single-Comb White Leghorns was begun in 1922, and chicks from the first series of these matings were obtained in the following spring. Vigor, early maturity, and general good quality are the desirable characteristics sought in making these matings.

### POULTRY FEEDING.

Thirty-two pens of fowls, about one-fourth of which were yearlings, were used in feeding investigations. A part of this work is in verification of previous tests in the use of varying quantities and kinds of animal and vegetable proteins.

Rations containing several of the vegetable proteins have been used again in various combinations with animal proteins and dried-milk products. The use of these vegetable proteins seems to be chiefly supplementary to the animal proteins, although one of the vegetable protein rations, with an added mineral mixture of bone phosphate, sodium chlorid, and calcium carbonate, is giving fairly satisfactory results.

The use of gluten meal seems to have an excellent effect on fowls during the molting season, and a small percentage has been added to the ration in several pens. Comparisons of costs in the use of dried or flaked milk, dried buttermilk, and semisolid buttermilk are being made.

The mash used successfully as a breeding and laying mash for the general-purpose breeds, containing only about 17 per cent of meat scrap and 33 per cent of ground oats and bran, continues to give good results, particularly in hatchability and fertility of eggs. The more stimulating rations seem to cause an overfat condition in the general-purpose breeds, especially during the second year of production.

The effect of feeding rations on the vitamin content of eggs and their fertility and hatchability is being studied.

Substantial progress has been made in an experiment in cooperation with the Biochemic Division to determine the content of vitamins A and B in the flesh, gizzard, heart, and liver of fat hens of three or more general-purpose breeds of poultry, and also in eggs and in frying chickens fed on different rations.

### SOUTHWESTERN POULTRY INVESTIGATIONS.

Breeding and feeding investigations with poultry are being carried on at Glendale, Ariz. Considerable data on southwestern conditions have been assembled.

The Bronze Turkey breeding stock purchased last year is in a thrifty condition. Investigations in the various phases of turkey production will probably become the main line of research at this station.

### PIGEON AND SQUAB INVESTIGATIONS.

Squab-breeding investigations have been continued with White Kings and Carneaux. Further information on feed costs in squab production has been obtained, as well as additional data on weights and rate of growth in breed comparison.

## DAIRY DIVISION.

The work of the Dairy Division, under Dr. C. W. Larson, chief, has been carried out in accordance with the policy of laying special emphasis on research problems. The results of investigations in production and manufacturing are encouraging. Attention was devoted to fundamentals, and some new discoveries were made which have a direct and practical bearing upon the efficiency of production, sanitation, and utilization of dairy products. New principles were introduced where it was thought that these principles were worthy of being given field trials, and tried principles were taken into new fields. The usual regulatory work of the division was continued.

### DAIRY INTRODUCTION.

#### COW-TESTING ASSOCIATIONS.

The tabulation and study of cow-testing association records were continued. The records show that in well-managed associations there is a gain in average yearly production per cow from year to year. For example, the average production of butterfat per cow in three associations (one each in Michigan, Ohio, and Pennsylvania) was as follows: First year, 237 pounds; second year, 255 pounds; third year, 278 pounds; fourth year, 292 pounds; fifth year, 305 pounds. The fifth-year average production was 68 pounds above that of the first year. At 40 cents a pound this increase of butterfat would have a value of $27.20, and for a herd of 20 cows the increased value would be $544.

The production records of 17,405 purebred, grade, and scrub cows showed that in milk production the purebreds and grades excelled the scrubs by 12.42 per cent and in butterfat production by 17.86 per cent.

Other studies of association records and comparisons between such records and those of the Government dairy farm at Beltsville, Md., are under way, but have not advanced far enough to warrant publication.

#### COOPERATIVE BULL ASSOCIATIONS.

Preliminary reports indicate that the number of active cooperative bull associations increased about 15 per cent during the year. In Idaho the number increased from 9 in 1922 to 29 in 1923. The value of using good bulls on the association plan is indicated by the compilation of data on the milk and butterfat production of daughters of association bulls as compared with the dams of those daughters. Seventy such daughters whose records have been compiled showed an average increase, over their dams, of 22.22 per cent in milk production and 25.21 per cent in butterfat production.

#### CREAMERY MANAGEMENT.

The efficiency of creamery operation has been studied through the unit cost of manufacture of the various products made at the Grove City Creamery, Grove City, Pa. Data on the various phases of this problem have been collected, tabulated, and summarized and a report prepared. This study has been completed at Grove City, but will be continued at other plants.

In the study of the cost of hauling milk and cream it was found that the hauling charge averaged 10 per cent of the price the farmer received for his butterfat, with an additional charge for hauling skim milk.

The Grove City Creamery has completed its eighth year of operation. Butter is still the principal product, but a good trade has been built up in sweet cream and ice-cream mix, especially during the summer months. The quality of the butter has been kept up to a high standard and the local markets for this product have increased. The other products have also sold for better prices than in the preceding two years.

### CHEESE INTRODUCTION.

Introduction of improved methods of manufacturing Swiss cheese has been continued in three States. The cooperating factories follow the recommendations of the department field men, furnish facilities for growing the necessary cultures, keep an accurate record of the manufacture of each cheese, and permit the field men to grade the cheese at the time of sale.

In Ohio, 6 factories, which cooperated with the field men, made 2,463 cheeses, of which 41.7 per cent were graded fancy, 47.4 per cent No. 1, and 10.9 per cent No. 2. The combined total of 89.1 per cent fancy and No. 1 compares very favorably with 30 per cent fancy and No. 1 averaged by factories following old methods.

In Wisconsin, 17 factories showed a range from 50 per cent fancy and No. 1 cheese in factories where the cultural methods were not followed completely to 92.7 per cent in one of the best-conducted plants.

The manufacture of Swiss cheese in North Carolina has been undertaken as a trial to determine whether or not it is possible to make this kind of cheese under conditions existing there.

The work on American cheese, begun several years ago in several Southern States, has been continued.

### WESTERN DAIRY INTRODUCTION.

In connection with the work of dairy introduction in the Western States, 27 new bull associations, owning 136 purebred bulls, were organized, and there was an increase of 15 cow-testing associations and approximately 20,000 cows.

Efforts were made to improve the quality of creamery butter by the introduction of cream grading, by which cream is paid for on a quality basis, and as a result 50 creameries in the western territory have adopted some system of grading cream. The educational butter-scoring contests were continued.

The work with factories producing Cheddar cheese consisted very largely in introducing better methods of manufacture, in bringing about greater care on the part of the farmers to produce clean milk and deliver it to the factories properly cooled in good time in the forenoon, in giving short courses for cheesemakers, and in conducting an educational monthly scoring contest.

Surprise milk contests were introduced in three new cities, besides becoming more firmly established in the older contest cities.

Progress was made in the dairy-development project at Delhi, Calif., in cooperation with the extension department of the University of California. The dairy field man visited farms, organized and addressed meetings in the interest of the selection and feeding of animals, dairy management, location and construction of buildings, field crops, etc., and assisted in the work of cow-testing and bull associations, and in work with fairs.

### RENOVATED BUTTER.

The inspection of renovated-butter factories was conducted at 6 plants, with particular attention to the sanitary condition of the factory, quality of packing stock, manufacturing processes, and moisture content of the finished product. The output was 4,003,403 pounds, a decline of more than 25 per cent from the preceding year.

### SUPERVISION OF BUTTER FOR THE NAVY.

In continuation of cooperation with the Navy Department in obtaining for the Navy a high grade of butter made from sweet cream under definite manufacturing standards, the Dairy Division supervised the manufacture of 100,000 pounds of this butter in the season of 1922. Samples were scored June 15, 1923, with an average score of 93.

### SUPERVISION OF JUDGING CONTESTS.

The Dairy Division supervised the students' national contest in judging dairy cattle and the contest in judging dairy products held in connection with the National Dairy Show on the Minnesota fairgrounds in October, 1922, also the students' contest in judging dairy products at the Eastern States Exposition, Springfield, Mass., September 19, 1922. These contests are very helpful in unifying instruction in these subjects in agricultural colleges and high schools.

### UTILIZATION OF MILK.

The educational "milk-for-health" campaigns, with the purpose of increasing the use of milk as a means of reducing undernourishment, particularly among children, and of improving the health of persons of all ages, were continued, in cooperation with the extension services of State agricultural colleges. The division cooperated in 8 demonstration campaigns in 6 States. After the demonstration campaigns have been held the work is turned over to the local workers, who extend it to other communities. The character and methods of conducting these campaigns were described in Department Circular 250, issued during the year.

## MARKET MILK INVESTIGATIONS.

### DAIRY SANITATION.

At the request of city authorities surveys to determine the status of the milk supply were made at Atlanta, Ga., Birmingham, Ala., Meridian, Miss., Fort Wayne, Ind., St. Louis, Mo., Charlottesville, Va., New Haven, Conn., Fall River, Mass., and Attleboro, Mass. Ac-

cording to the nature of the various requests, instructions were given to local inspectors, and authorities were advised regarding local milk ordinances, laboratory control work, and follow-up work.

Monthly circular letters to milk inspectors have been issued as a means of spreading information calculated to improve milk supplies from the sanitary standpoint. Department Circular 276, "Inspection of Milk Supplies," was prepared with a similar purpose.

At Grove City, Pa., studies were made of the conditions and methods necessary to produce milk of such quality as to make possible the manufacture of Swiss cheese of high quality by the use of both night's and morning's milk delivered once a day instead of twice a day. From observations made it is apparent that milk of satisfactory quality to make good cheese can be produced on an average farm with once-a-day delivery, and that milk coolers and small-top pails are of great help in improving the quality of the milk, but care must be taken in washing and sterilizing them.

### MILK-PLANT MANAGEMENT.

Labor costs and requirements in 75 milk plants in 12 cities were studied, and the results were used as the basis of circular letters known as milk-plant letters, which are given a wide circulation among milk-plant operators.

Studies on the cream line in milk, as affected by different types of machines, pasteurizing and holding temperatures, cooling, and other processes in milk plants were undertaken in cooperation with the Minnesota State board of health, and some interesting facts have been discovered.

Many plans for milk plants were sent out during the year, and assistance was given to visitors and correspondents in planning and rearranging plants.

### REQUIREMENTS FOR MILK PRODUCTION.

Further study was made of records previously obtained in investigations of requirements for producing milk, and additional facts were collected for use in preparing a paper discussing basic factors in economical milk production.

A study of the turnover of cows in dairy herds revealed the fact that the average length of time that a cow remains in a milking herd is 4.2 years. Cows other than those condemned because of tuberculosis remain for 5.7 years. The difference due to tuberculosis is significant.

Studies were made of the cost and other requirements for raising dairy heifers in Indiana and Vermont, and the results have been prepared for publication. It was found that in Indiana 48.8 per cent and in Vermont 36.5 per cent of the cost of raising a heifer calf to milking age were incurred during the first six months of her life.

### MILKING MACHINES.

The cleaning and sterilizing of milking machines and the length of life of the rubber parts were subjects of further study. The method of sterilization by heat was found to give uniformly better results in reducing the number of bacteria in both hot and cold

weather than the use of either chlorin solution or salt and chlorin solution.

The length of life of teat-cup rubbers under heat sterilization varied from 51 to 95 days. Investigations of teat-cup rubbers made by the Bureau of Standards from material furnished by the Dairy Division led to the conclusions that such rubbers should be properly cleaned before sterilization, as any butterfat remaining on them has a deleterious effect at the sterilization temperature, and that in order to render good service the rubbers should be made from a so-called "pure gum" compound.

### OTHER ACTIVITIES.

A test for determining the holding time of continuous-flow pasteurizers was devised. Tests were made at commercial plants in several localities. Experimental tanks in the department laboratories were also used to study flows and to check up the field experiments. The results obtained are of great importance to machinery manufacturers, milk dealers, and health officials.

A galvanized-iron box steam sterilizer for dairy utensils was set up and operated to obtain data on its economy and efficiency. A temperature of 99.4° C. was reached in 35.7 minutes and maintained for 12.7 minutes with 14.7 pounds of corncobs for fuel. The average bacteria count of the interior surfaces of 10-gallon milk cans was reduced from 48,366,666 to 1,667. Tests were made with steamed and unsteamed cans held covered for 24 and 48 hours in warm weather. Unsteamed cans having a bacteria count of 154,000,000 contained more than 18,000,000,000 at the end of 24 hours, while steamed cans having a count of 3,400 immediately after steaming and left practically dry had only 7,900 in the same time. The bacteria count on steamed cans left damp for 48 hours increased from 4,400 to nearly 6,000,000.

Experiments concerning the effect of feeds on flavor and odor of milk were continued. The work with green alfalfa, green corn, and turnips has been completed and the results prepared for publication. The conclusions are, in the main, similar to those reached with the feeding of silage as reported in Department Bulletin 1097.

Other subjects under study are the relationship between the bacteria count of whole milk and that of the cream and skim milk resulting from its separation, the factors affecting the foaming of milk and cream, and factors affecting the viscosity of cream. From data so far obtained it is apparent that the viscosity of cream is increased as the temperature is lowered and the fat percentage increased, and that it is lessened by holding the cream at a high temperature and then chilling it.

### DAIRY RESEARCH LABORATORIES.

The work of the dairy research laboratories is of a technical character and much of it is unsuitable for detailed description in a report of this kind. It has a practical bearing, however, on the solution of many dairy problems and adds to the store of knowledge of dairy science. Results are published from time to time in department bulletins and technical journals.

### NUTRITION AND MILK SECRETION.

In previously reported nutrition experiments it was found that certain minerals taken in the feed had a marked effect on the milk flow and condition of the dairy cow. Further experiments have been carried on to determine whether the effect of feeding calcium carbonate is caused specifically by the calcium or by the changing of the acid-base balance. Sodium carbonate was substituted for the calcium carbonate, and the results show that sodium carbonate had no effect on milk yield when added to a timothy-hay ration, whereas the calcium carbonate did affect the yield perceptibly. In an experiment where the cow was fed a ration varying in diet protein, it was found that the diet protein may effect changes in the composition of the milk.

### BACTERIOLOGY AND CHEMISTRY OF MILK.

Further studies were made of the characteristics and identity of certain species of streptococci that are found in milk and some of which are also found in the mouths and in the feces of cows. A study of the milk-souring streptococci has been completed.

A harmless organism which grows rapidly during the pasteurizing process and which has been termed *Lactobacillus thermophilus* has been found to be a cause of so-called "pin-point" colonies on culture plates from pasteurized milk. The presence of this organism, which survives ordinary pasteurization, complicates the problem of transporting milk in a hot condition. The organism is destroyed at a temperature of 180° F.

Considerable attention has been paid to the phenomenon of bacterial growth and several points of technical importance have been established.

In studies relating to the chemistry of milk products the relative importance of moisture, acidity, and light in the oxidation of butterfat was determined, and the condition known as tallowiness in butterfat was found to be due to oxidation by-products, though the mechanism of the reaction has not been fully determined. Pure butterfat of excellent keeping quality has been prepared from fresh butterfat by thorough washing of the fat and also by controlled steam distillation.

### MANUFACTURE OF MILK PRODUCTS.

Condensed milk.—In the process of condensing and evaporating milk it is necessary that milk be forewarmed before it is drawn into the vacuum pan. Experiments by the Dairy Division during the year show that the temperature of forewarming has a marked effect on the coagulation of the finished condensed product. In the case of the unsweetened evaporated milk it was found that the best forewarming temperature was between 95° and 100° C. Sweetened condensed milk gave the best results when the forewarming temperature was between 55° and 65° C. When the raw milk was forewarmed at other temperatures there was a tendency for the milk to coagulate in the can upon storage in the case of condensed milk or during the sterilizing process in the case of evaporated milk.

Ice cream.—The solubility of lactose in cane-sugar solution and ice-cream mixes has been determined. Lactose is slightly less soluble in cane-sugar solutions than in pure water. In an ice-cream mix the solubility is about that of a corresponding cane-sugar solution. Other characteristics of a technical nature have been noted.

Swiss cheese.—On the basis of the results of experimental work recommendations were made to factories producing the Swiss type of cheese in Ohio as to the ratio of fat to casein which should be maintained. All factories which followed these recommendations had no trouble from what is known as "glass cheese," while four factories which failed to comply with these instructions had trouble in that respect.

The use of a centrifuge to improve the "eye" formation was given an extensive factory test. This treatment almost invariably resulted in a cheese with a reduced number of large eyes. Of 241 cheeses made at the Grove City, Pa., creamery from separated milk 77.6 per cent were fancy, 7.1 per cent were No. 1, and 15.3 per cent No. 2. Of 109 cheeses made from unseparated milk 30.3 per cent were fancy, 52.3 per cent were No. 1, and 17.4 per cent were No. 2.

Difficulties because of too rapid eye development and undue swelling of the cheeses were found to be due to certain organisms which were identified, and means of prevention were devised.

Roquefort cheese.—The manufacture of cow's-milk Roquefort cheese was continued at the Grove City Creamery, and further improvements were made.

### UTILIZATION OF DAIRY BY-PRODUCTS.

When ordinary sour milk is condensed in a vacuum, following the procedure adopted in making concentrated buttermilk for poultry feed, the milk forms lumps with more or less separation of whey. It has been found that if the soured milk is homogenized a smooth product is obtained. If the acidity of the milk is below 1 per cent the finished product will ferment. A high acidity may be obtained by a combination of cultures. The combination of high acid and homogenizing gives a smooth, very acid product which keeps indefinitely. There is a large demand for a product of this kind at a price which should make it a profitable outlet for skim milk.

Practical tests in cooperation with three large paper manufacturing concerns showed that rennet casein can be used satisfactorily in sizing paper.

An effort is being made to develop further uses for milk sugar, as large quantities of this substance are now wasted. Some successful processes have been developed.

### DAIRY EXPERIMENT FARM.

Many good records have been made in the dairy herd at the Government dairy experiment farm at Beltsville, Md. The health of the herd shows improvement, abortion being less prevalent than formerly.

In a comparative test in which cows were kept in box stalls and in stanchions for alternating periods, the cows in box stalls gave a little more milk and very slightly more butterfat and gained more

in body weight than when kept in stanchions. The value of the increased product is less than the additional expense of bedding and labor for keeping in box stalls, and this method is not to be advised except where maximum production is desired regardless of expense.

Twelve cows in alternating periods were milked so as to test the effect of changing milkers. In the first and third periods each cow was always milked by the same man; in the second period never by the same man twice in succession. When the same man did the milking the average yield showed a very slight increase, 0.6 per cent of milk and 0.4 per cent of butterfat.

Feeding 3 pounds a day of grain above the Savage feeding standard caused a daily increase of 1.6 pounds of milk, 0.09 pound of butterfat, and 0.32 pound of body weight.

Cows fed a small quantity of roughage and a liberal quantity of grain produced and gained more than those fed scantily with grain and liberally with roughage. Since both groups were fed in accordance with the Savage standard, it is evident that the digestible nutrients in concentrates are worth more than an equal weight in roughage.

Cows were fed a definite small quantity of hay, followed by all the silage they would eat, with grain sufficient to bring the total nutrients to standard, and the quantity of silage taken was noted. Later they were fed a larger quantity of hay, followed by their fill of silage as before, and it was found that for every additional pound of hay they ate almost exactly 1 pound less of silage, the total of roughage remaining the same. Since hay contains more nutrients than silage, using the larger ration of hay reduces the amount of grain needed. The quantity of total roughage consumed seems to be dependent on individual size and nature rather than on the quantity of milk produced.

Hydrolyzed sawdust, a by-product in the manufacture of industrial alcohol, was found by experiment to contain a large proportion of material that has no feeding value. This chemically treated sawdust can be used in limited quantities for dairy cows, but it possesses so little nutritive value that its use is inadvisable at present prices of feed and cost of treating sawdust.

Experiments to find out whether magnesium is the element in prickly pear which lowers the fat content of milk indicate that magnesium has little or no influence in this respect.

Tests of butterfat in the milk of all cows at the farm, made in January and July, were studied. There are 166 cows with at least one test in each of these months. The lowering of the fat in summer as compared with winter varies from 0.02 to 0.72 per cent.

Experiments are in progress: To ascertain the influence of feeding a large quantity of hay and a small quantity of silage compared with reversed quantities of these feeds; to gain information by which to revise the Wolff-Lehmann standards for growing dairy animals; to see how much extra feed first-calf heifers need in order to make normal growth while giving milk; and to determine whether the frequency of feeding hay affects the quantity consumed and the milk production.

### DAIRY CATTLE BREEDING INVESTIGATIONS.

The registered purebred dairy cattle in the five herds where breeding projects are under way now number 366. Official records have

been completed with 135 cows representing three breeds, the average production per cow being 13,087 pounds of milk and 509 pounds of butterfat. From these herds 63 bulls have been lent to agricultural colleges and dairy farmers who are cooperating in the breeding investigations.

The breeding projects at Beltsville have progressed favorably. During the year a second bull, unrelated to the first one, was introduced for use in the line-breeding and outcrossing project.

The results of a study on the effect of age and development on butterfat production of Register-of-Merit Jerseys and Advance-Register Guernseys was prepared for publication, and this was followed by a similar study of Advanced-Registry Ayrshire cows.

Studies of the transmitting abilities of Holstein, Guernsey, and Ayrshire sires are in progress.

### DAIRY ENGINEERING AND TECHNOLOGY.

Information was furnished on the construction of buildings and other problems in dairy engineering in reply to inquiries on those subjects. Many blue prints of barn plans were sent out.

Plans and specifications were prepared for construction work, equipment, and apparatus required by the division, including surveys, purchases, and construction at the Beltsville farm. The latter work included plans and specifications for a new nutrition barn, the completion of a sewage-disposal plant and sewer lines, additions and improvements in the barns and the underground heating system, and surveying on the new leased farm of 129 acres.

Plans and specifications were prepared for a refrigerating plant in the bureau and work was done in connection with installation. Plans and specifications were also prepared for an electric plant at McNeill, Miss.; laboratories, refrigerating plant, gas plant, etc., for the Animal Husbandry Division; a pumping plant at Bethesda, Md., and an abattoir at Beltsville, Md.

A paper on the automatic control of low temperatures was prepared.

## MEAT INSPECTION DIVISION.

The Federal meat inspection, conducted by the Meat Inspection Division, under Dr. R. P. Steddom, chief, shows the largest volume of slaughter in the history of the service. As compared with the preceding year there was an increase of more than 10,000,000 in the total number of animals slaughtered (the increase being mainly in swine) and also an increase in the quantity of meats processed and in the quantity of meats and products certified for export.

### GENERAL INSPECTION OF MEATS.

Inspection was conducted at 867 establishments in 261 cities and towns, as compared with 899 establishments in 263 cities and towns during the fiscal year 1922. Inspection was begun at 55 establishments and withdrawn from 52, as compared with 68 and 46, respectively, during the preceding year. Inspection was withdrawn from 51 establishments on account of discontinuance of interstate business and from 1 on account of insanitary condition.

ANTE-MORTEM AND POST-MORTEM INSPECTIONS.

The ante-mortem and post-mortem inspections are given in the following tables:

*Ante-mortem inspection of animals.*

| Class of animals. | Passed. | Suspected.[1] | Condemned.[2] | Total inspected. |
|---|---|---|---|---|
| Cattle | 8,882,803 | 146,948 | 30 | 9,029,781 |
| Calves | 4,321,072 | 5,011 | 9 | 4,326,092 |
| Sheep | 11,402,717 | 1,462 | 8 | 11,404,187 |
| Goats | 25,104 | 25 | ..... | 25,129 |
| Swine | 48,541,309 | 104,067 | 3,364 | 48,648,740 |
| Horses | 1,459 | ..... | 1 | 1,460 |
| Total | 73,174,464 | 257,513 | 3,412 | 73,435,389 |

[1] This term is used to designate animals found or suspected of being unfit for food on ante-mortem inspection, most of which are afterwards slaughtered under special supervision, the final disposal being determined on post-mortem examination.
[2] For additional condemnations see succeeding tables.

*Post-mortem inspection of animals.*

| Class of animals. | Passed. | Condemned. | Total inspected. |
|---|---|---|---|
| Cattle | 8,956,236 | 73,300 | 9,029,536 |
| Calves | 4,325,965 | 11,815 | 4,337,780 |
| Sheep | 11,390,386 | 13,317 | 11,403,703 |
| Goats | 25,048 | 81 | 25,129 |
| Swine | 48,403,744 | 196,325 | 48,600,069 |
| Horses | 1,446 | 13 | 1,459 |
| Total | 73,102,825 | 294,851 | 73,397,676 |

The next two tables show the diseases and conditions for which condemnations were made.

*Diseases and conditions for which condemnations were made on ante-mortem inspection.*

| Cause of condemnation. | Cattle. | Calves. | Sheep. | Goats. | Swine. | Horses. |
|---|---|---|---|---|---|---|
| Abscess | ..... | ..... | ..... | ..... | 90 | ..... |
| Arthritis | ..... | ..... | ..... | ..... | 1 | ..... |
| Blackleg | ..... | 1 | ..... | ..... | ..... | ..... |
| Congestion | ..... | ..... | ..... | ..... | 2 | ..... |
| Emaciation | 1 | ..... | ..... | ..... | 30 | ..... |
| Frozen | ..... | ..... | ..... | ..... | 1 | ..... |
| Hog cholera | ..... | ..... | ..... | ..... | 2,088 | ..... |
| Injuries | 2 | 6 | ..... | ..... | 4 | ..... |
| Milk fever | 2 | ..... | ..... | ..... | ..... | ..... |
| Moribund | 2 | ..... | ..... | ..... | 24 | ..... |
| Necrosis | 1 | ..... | ..... | ..... | ..... | ..... |
| Pneumonia | 3 | ..... | ..... | ..... | 104 | ..... |
| Pregnancy and recent parturition | 1 | ..... | ..... | ..... | 4 | ..... |
| Pyemia | ..... | ..... | ..... | ..... | 76 | ..... |
| Pyrexia | 10 | 2 | 8 | ..... | 903 | ..... |
| Septicemia | 5 | ..... | ..... | ..... | 16 | ..... |
| Sexual odor | ..... | ..... | ..... | ..... | 1 | ..... |
| Swine plague | ..... | ..... | ..... | ..... | 19 | ..... |
| Tetanus | ..... | ..... | ..... | ..... | 1 | 1 |
| Tuberculosis | 2 | ..... | ..... | ..... | ..... | ..... |
| Tumors | 1 | ..... | ..... | ..... | ..... | ..... |
| Total | 30 | 9 | 8 | ..... | 3,364 | 1 |

*Diseases and conditions for which condemnations were made on post-mortem inspection.*

| Cause of condemnation. | Cattle. | | Calves. | | Sheep. | | Goats. | | Swine. | | Horses. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Carcasses. | Parts. | Carcasses. | Parts. | Carcasses. | Parts. | Carcasses. | Parts. | Carcasses. | Parts | Carcasses. | Parts. |
| Actinomycosis | 785 | 101,097 | 45 | 1,468 | ..... | 3 | .... | .... | 12 | 74 | .... | .... |
| Anthrax | 6 | ..... | ..... | ..... | ..... | ..... | .... | .... | ..... | ..... | .... | .... |
| Arsenic poisoning | 2 | ..... | ..... | ..... | ..... | ..... | .... | .... | ..... | ..... | .... | .... |
| Asphyxia | 7 | ..... | 9 | ..... | 70 | .... | .... | .... | 1,330 | ..... | .... | .... |
| Blackleg | 10 | 40 | 3 | ..... | ..... | ..... | .... | .... | ..... | ..... | .... | .... |
| Bone diseases | 139 | 45 | 161 | 21 | 288 | 91 | .... | .... | 6,101 | 110 | .... | .... |
| Caseous lymphadenitis | ..... | ..... | ..... | ..... | 950 | 6 | 5 | 1 | ..... | ..... | .... | .... |
| Cellulitis | ..... | ..... | ..... | ..... | ..... | ..... | .... | .... | 98 | 408 | .... | .... |
| Congestion | 5 | 5 | 10 | ..... | 7 | .... | .... | .... | 72 | 1 | .... | .... |
| Contamination | 19 | 2,610 | ..... | 1 | ..... | 25 | .... | .... | 614 | 879 | .... | .... |
| Cysticercus | 167 | 1,348 | 81 | 5 | 207 | 2 | .... | .... | 225 | 56 | .... | .... |
| Dropsical diseases | 30 | ..... | 3 | ..... | 5 | .... | 1 | .... | 76 | ..... | .... | .... |
| Emaciation | 4,895 | ..... | 1,796 | ..... | 2,240 | .... | 26 | .... | 1,331 | ..... | 1 | .... |
| Frozen | ..... | ..... | ..... | ..... | ..... | ..... | .... | .... | 3 | ..... | .... | .... |
| Gangrene | 49 | ..... | 37 | ..... | ..... | ..... | .... | .... | 21 | ..... | .... | .... |
| Hog cholera | ..... | ..... | ..... | ..... | ..... | ..... | .... | .... | 28,815 | 21 | .... | .... |
| Hydronephrosis | ..... | ..... | ..... | 1 | 3 | .... | .... | .... | 10 | ..... | .... | .... |
| Icterus | 103 | ..... | 127 | ..... | 2,079 | .... | 2 | .... | 6,154 | 1 | .... | .... |
| Immaturity | ..... | ..... | 4,257 | ..... | ..... | ..... | .... | .... | ..... | ..... | .... | .... |
| Injuries, bruises, etc | 3,612 | 441 | 697 | 50 | 560 | 105 | 1 | 2 | 1,723 | 10,846 | .... | 1 |
| Leukemia | 314 | 22 | 57 | ..... | 11 | 4 | .... | .... | 277 | ..... | .... | .... |
| Melanosis | 106 | 22 | 121 | 2 | 33 | 5 | 1 | .... | 204 | 5 | 1 | .... |
| Moribund | 10 | ..... | 33 | ..... | 71 | .... | .... | .... | 148 | ..... | .... | .... |
| Necrobacillosis | 3 | 221 | ..... | 5 | ..... | 3 | .... | .... | ..... | ..... | .... | .... |
| Necrosis | 11 | 554 | ..... | ..... | ..... | 2 | .... | .... | 1 | ..... | .... | .... |
| Parasitic diseases | 11 | 8 | 1 | ..... | 9 | .... | .... | .... | 126 | ..... | .... | .... |
| Phlebitis | ..... | ..... | 216 | 1 | ..... | .... | .... | .... | ..... | ..... | .... | .... |
| Pneumonia, peritonitis, enteritis, metritis, pleurisy, etc | 8,181 | ..... | 2,310 | ..... | 5,480 | .... | 8 | .... | 31,776 | ..... | 6 | .... |
| Pregnancy and recent parturition | 222 | ..... | ..... | ..... | 30 | .... | 28 | .... | 39 | ..... | .... | .... |
| Septicemia, pyemia, uremia, etc | 3,368 | ..... | 926 | ..... | 1,101 | .... | 4 | .... | 21,333 | ..... | 4 | .... |
| Sexual odor | 1 | ..... | ..... | ..... | 4 | .... | 5 | .... | 3,868 | ..... | .... | .... |
| Skin diseases | 2 | ..... | ..... | ..... | 23 | .... | .... | .... | 83 | 6 | .... | .... |
| Texas fever | 71 | ..... | 115 | ..... | ..... | ..... | .... | .... | ..... | ..... | .... | .... |
| Tuberculosis | 49,839 | 67,199 | 747 | 560 | 8 | .... | .... | .... | 88,688 | 783,136 | .... | .... |
| Tumors and abscesses | 1,332 | 2,720 | 63 | 269 | 138 | 46 | .... | 1 | 3,199 | 36,774 | 1 | .... |
| Total | 73,300 | 176,332 | 11,815 | 2,383 | 13,317 | 292 | 81 | 4 | 196,325 | 832,317 | 13 | 1 |

The following table shows the total condemnations on ante-mortem and post-mortem inspections combined:

*Summary of condemnations.*

| Class of animals. | Animals or carcasses. | Parts. |
|---|---|---|
| Cattle | 73,330 | 176,332 |
| Calves | 11,824 | 2,383 |
| Sheep | 13,325 | 292 |
| Goats | 81 | 4 |
| Swine | 199,689 | 832,317 |
| Horses | 14 | 1 |
| Total | 298,263 | 1,011,329 |

In addition to the foregoing, the carcasses of 97,445 animals found dead or in a dying condition were tanked, as follows: Cattle, 3,373; calves, 3,796; sheep, 8,703; goats, 86; swine, 81,486; horses, 1.

INSPECTION OF MEAT AND PRODUCTS.

The inspection and supervision of meats and products prepared and processed are shown in the following table, which is a record only of inspection performed and not a statement of the aggregate quantity of products prepared. The same product is sometimes duplicated by being reported in different stages of preparation under more than one heading.

*Meat and meat food products prepared and processed under supervision.*

| Kind of product. | "Inspection pounds." | Kind of product. | "Inspection pounds." |
|---|---|---|---|
| Placed in cure: | | Lard oil | 3,536,133 |
| Beef | 167,278,223 | Lard stearin | 2,429,550 |
| Pork | 3,366,258,504 | Compound and other substitutes for lard | 336,843,159 |
| All other | 52,085,646 | Oleo stock and edible tallow | 60,908,230 |
| Sausage, chopped | 679,314,965 | Oleo oil | 150,340,208 |
| Canned product: | | Oleostearin | 66,888,641 |
| Beef | 134,419,618 | Oleomargarin | 129,767,495 |
| Pork | 22,489,528 | Miscellaneous | 1,642,417,522 |
| All other | 3,222,534 | Horse meat: | |
| Sterilized product: | | Cured | 168,700 |
| Beef | 2,829,143 | Canned | 149,906 |
| Pork | 8,075,671 | | |
| All other | 4,656 | | |
| Pork to be eaten uncooked | 40,627,497 | Total | 8,888,546,527 |
| Meat extract | 552,491 | | |
| Lard | 2,017,938,507 | | |

The following quantities of meat and meat food products were condemned on reinspection on account of having become sour, tainted, unclean, rancid, or otherwise unwholesome: Beef, 5,197,123 pounds; pork, 8,837,315 pounds; mutton, 58,277 pounds; veal, 56,478 pounds; goat meat, 188 pounds; horse meat, 12,100 pounds; total, 14,161,481 pounds.

MARKET INSPECTION.

Market inspection, to facilitate interstate deliveries of meats and products, was conducted in 24 cities.

MEAT AND PRODUCTS CERTIFIED FOR EXPORT.

The following products were certified for export: Beef and beef products, 194,923,114 pounds; pork and pork products, 1,842,651,273 pounds; mutton and mutton products, 3,425,950 pounds; total, 2,041,000,337 pounds. In addition 10 certificates were issued covering the export of 183,484 pounds of horse-meat products and 2,672 certificates covering the export of 51,467,350 pounds of inedible animal products.

EXEMPTION FROM INSPECTION.

The provisions of the meat-inspection law requiring inspection usually do not apply to animals slaughtered by a farmer on the farm nor to retail butchers and dealers supplying their customers. The retail butchers and dealers, however, in order to ship meat and meat-food products in interstate or foreign commerce, are required to

obtain certificates of exemption. The number of exemption certificates outstanding at the close of the fiscal year was 1,471, a decrease of 1,370 under the preceding year. This decrease resulted largely from a special investigation conducted during the year. During the year 1,724 certificates were canceled, 1,533 on account of the dealers retiring from business or ceasing to make interstate shipments, 127 for violations of the regulations, and 64 on account of handling only farm-dressed or "U. S. inspected and passed" products.

During the year 36,132 shipments were made by retail dealers and butchers holding certificates of exemption, as compared with 36,477 shipments during the fiscal year 1922. The shipments of the year covered products as shown in the following table:

*Shipments by retail dealers and butchers under certificates of exemption from inspection.*

| Product. | Number. | Pounds. |
|---|---|---|
| Beef, carcasses (1,544 quarters) | 386 | 174,346 |
| Veal, carcasses | 31,608 | 2,878,568 |
| Sheep, carcasses | 1,174 | 56,406 |
| Swine, carcasses | 1,204 | 111,770 |
| Beef, fresh | | 1,121,708 |
| Veal, fresh | | 219,587 |
| Mutton, fresh | | 186,562 |
| Pork, fresh | | 254,469 |
| Cured meats | | 232,351 |
| Lard | | 20,782 |
| Sausage | | 66,594 |
| Miscellaneous (scrapple, lard substitutes, headcheese, etc.) | | 19,295 |
| Total | 34,372 | 5,342,438 |

During the year 67,579 interstate shipments were made of meat and meat food products from animals slaughtered by farmers on the farm, as compared with 69,815 shipments in the fiscal year 1922. The following table shows the products comprising these shipments:

*Shipments of farm-slaughtered products under exemption from inspection.*

| Product. | Number. | Pounds. |
|---|---|---|
| Beef, carcasses (3,199 quarters) | 800 | 277,135 |
| Veal, carcasses | 98,878 | 8,618,296 |
| Sheep, carcasses | 3,152 | 110,010 |
| Swine, carcasses | 10,912 | 1,026,924 |
| Beef, fresh | | 48,717 |
| Veal, fresh | | 110,491 |
| Mutton, fresh | | 1,718 |
| Pork, fresh | | 155,091 |
| Cured meats | | 374,366 |
| Lard | | 158,547 |
| Sausage | | 80,011 |
| Miscellaneous (scrapple, tripe, headcheese, etc.) | | 19,598 |
| Total | 113,742 | 10,978,904 |

### INSPECTION OF IMPORTED MEATS.

The following table shows the inspection of imported meats and meat food products for the fiscal year:

*Imported meat and meat food products inspected.*

| Country of origin. | Fresh and refrigerated meats. | | Cured and canned meats. | Other products. | Total weight. |
|---|---|---|---|---|---|
| | Beef. | Other classes. | | | |
| | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* |
| Argentina | 10,896,610 | 4,002,010 | 2,439,424 | 731,115 | 18,069,159 |
| Australia | 265 | 110,053 | 230,256 | ..... | 340,574 |
| Brazil | 426,536 | 10,480 | 480,242 | 1,800 | 919,058 |
| Canada | 13,658,917 | 6,627,669 | 179,323 | 294,453 | 20,760,362 |
| New Zealand | ..... | 636 | 216 | ..... | 852 |
| Uruguay | 1,012,073 | 2,090,531 | 6,089,810 | ..... | 9,192,414 |
| Other countries | 5,567 | 29,985 | 216,044 | 313,699 | 565,295 |
| Total | 25,999,968 | 12,871,364 | 9,635,315 | 1,341,067 | 49,847,714 |

The following table shows the condemnations of imported meats and the amounts refused entry on account of lack of foreign certificate or other failure to comply with the regulations:

*Imported meat products condemned or refused entry.*

| Product. | Condemned. | Refused entry. |
|---|---|---|
| | *Pounds.* | *Pounds.* |
| Beef | 2,552 | 31,092 |
| Veal | ..... | ..... |
| Mutton | 23 | ..... |
| Pork | 532 | 7,003 |
| Total | 3,107 | 38,095 |

### INSPECTIONS FOR OTHER BRANCHES OF THE GOVERNMENT.

By request of other branches of the Government, reinspections of meats and meat food products to determine whether they remained wholesome and conformed to certain specifications were made during the year, as shown in the following table:

*Inspections for other branches of the Government.*

| Branch of Government. | Passed. | Rejected. |
|---|---|---|
| | *Pounds.* | *Pounds.* |
| Navy Department | 46,721,492 | 1,751,816 |
| Marine Corps | 3,989,554 | 117,972 |
| War Department | 812,279 | 1,747 |
| Interior Department (Indian Affairs) | 385,560 | ..... |
| Panama Railroad | 37,239 | 360 |
| Public Health Service | 271,411 | ..... |
| Shipping Board | 121,474 | 237 |
| War Veterans' Bureau | 89,246 | 337 |
| Total | 52,428,255 | 1,872,469 |

### LABELING MEATS AND PRODUCTS.

More than 28,000 labels, cartons, stencils, and other similar materials were submitted for approval. This number exceeded by approximately 18,000 that for the preceding year. Approximately 27,000 were approved, while about 1,000 were disapproved as not conforming to the regulations. Investigations resulted in eliminating from the current files 6,300 approvals which had become obsolete. Steps were taken to simplify the requirements for the approval and filing of labels and other materials.

As a result of investigations pertaining to the use of powdered milk in the preparation of meat and meat food products, regulations were issued to prevent the adulteration of products by means of water due to the absorbent properties of powdered milk and prohibiting the deceptive labeling of products containing that constituent.

### MEAT-INSPECTION LABORATORIES.

Laboratory analyses and examinations of meats and meat food products and of substances used in connection with their preparation were conducted in the meat-inspection laboratories located in the several districts throughout the country. The total number of samples analyzed was 64,195, of which 393 represented meat and meat food products offered for importation. Samples of 2,474 domestic and 90 foreign products were found not to be in accordance with the regulations. Samples of water supplies, curing materials, spices, condiments, cereals, coloring materials, denaturing oils, etc., were among those examined. Of 2,368 water samples, 362 showed evidence of pollution. All suspicious water supplies were kept under constant supervision and intensive study. Particular attention was given to improved bacteriological analyses of water which assist in determining the character of pollution and the application of remedial measures.

The bacteria naturally occurring in hog carcasses and their relation to meat souring were investigated with promise of beneficial results.

Methods for the analysis of colors were considerably improved, and a better method of coloring animal tissue, such as meat casings, was developed.

Practical demonstrations of the use of barium carbonate as rat poison in establishments under inspection were conducted.

Experiments were conducted with the use of sodium nitrite as a substitute for sodium nitrate in the curing of hams and bacon.

A method for the detection of milk powder in sausage was developed, thus preparing all laboratories to deal with attempts to use this substance without proper declaration.

The effect of mixing hydrogenated lard with lard was studied, and a method evolved by which lard to which hydrogenated lard has been added can be distinguished from lard adulterated with beef fat.

## FIELD INSPECTION DIVISION.

The Field Inspection Division, under Dr. A. W. Miller, chief, has continued its activities for the control and eradication of certain diseases of livestock, the enforcement of certain livestock quarantine

and transportation laws, and the administration of the regulations governing the importation and exportation of livestock and for the sanitary handling and control of hides, skins, wool, other animal by-products, hay, straw, etc., offered for entry into the United States.

### ERADICATION OF SCABIES.

Work for the eradication of scabies of sheep in cooperation with State officials was continued. Bureau employees made 22,796,623 inspections and supervised 6,714,961 dippings in the field. In addition, State authorities were assisted in arresting outbreaks in States where the work is not regularly carried on. The disease still exists to a considerable extent in several of the western range States, but there has been continued improvement.

In continuation of cooperative work for the eradication of cattle scabies, 2,398,646 inspections were made and 952,857 dippings were supervised by bureau employees in the field. The inspection reports indicate a somewhat larger number of infected cattle than in the preceding year in Colorado, Montana, New Mexico, Oklahoma, and Texas. A vigorous dipping campaign was undertaken for the summer of 1923, and it is expected that conditions will show improvement next year.

### ERADICATION OF DOURINE.

The campaign for the eradication of dourine of horses was conducted in cooperation with State livestock sanitary authorities and the Office of Indian Affairs, as in previous years. Only a small number of diseased animals were found in South Dakota, but the disease still prevails to a considerable extent in the range herds in Arizona, where the character and inaccessibility of the country make the prosecution of this work very difficult. Satisfactory progress has been made, however, and it is hoped that a few years more of cooperative work will result in the complete suppression of the disease. The number of animals tested and the results of the tests are reported by the Pathological Division.

### LIVESTOCK SANITARY WORK IN INTERSTATE COMMERCE.

In connection with the supervision of the interstate transportation of livestock to prevent the spread of animal diseases, bureau employees at market centers inspected 20,904,267 cattle, of which 12,775 were dipped under bureau supervision in order that they might continue in interstate commerce. Sheep to the number of 19,516,344 were also inspected for communicable diseases, and of these 1,004,480 were dipped under bureau supervision to comply with the regulations of the department or of the State of destination. Swine inspected numbered 46,161,878, and of these 458,097 were immunized against hog cholera under bureau supervision for distribution as feeding and breeding animals.

Upon request of transportation companies and shippers or to comply with laws of States to which shipments were destined, bureau veterinarians inspected 13,900 horses and mules, of which 6,982 were tested with mallein, none showing reaction.

During the year 20,547 cars carrying animals affected with communicable disease were received at points where the bureau has stations. In compliance with department regulations or on request of

Canadian Government officials, State officials, or transportation companies, 47,308 cars were cleaned and disinfected under bureau supervision.

All ruminants and swine received at public stockyards were carefully inspected for foot-and-mouth disease by experienced veterinarians specially assigned to that work, as has been the practice for a number of years, in order that there might be no delay in the control and eradication of the disease should an outbreak occur. No cases were detected.

### ENFORCEMENT OF TRANSPORTATION AND QUARANTINE LAWS.

The bureau has continued to report to the Solicitor of the department, for presentation to the Attorney General for prosecution, cases of apparent violations of livestock transportation and quarantine laws. The enforcement of the so-called 28-hour law (prohibiting the confinement of animals in cars, etc., longer than 28 hours without feed, water, and rest) has resulted in the provision by transportation companies of better facilities for the feeding, watering, and resting of livestock in transit. Many cases under these laws have required special investigation on the part of bureau employees, such as interviewing witnesses and examining railroad and other records for the completion of evidence. Four bureau employees were regularly assigned to this service, although the greater part of the work of collecting evidence and preparing and submitting reports is done by bureau employees at stockyard centers in connection with their other duties.

### INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

Throughout the year every possible care was taken to prevent the introduction of disease into the United States through the importation of livestock from foreign countries, and there has been strict adherence to the rule against permitting importations of cattle, sheep, goats, or swine from countries in which foot-and-mouth disease or other serious diseases of livestock exist. As England experienced repeated outbreaks of foot-and-mouth disease during the year, no ruminants or swine were permitted importation from that country. Cattle, sheep, and swine originating in Scotland were permitted to come forward direct from Scottish ports, and the importation of cattle from the Channel Islands was permitted on condition that they be shipped without landing in England, until June 26, when an outbreak of foot-and-mouth disease on the island of Jersey made it necessary to discontinue the issuance of permits and to cancel those outstanding on that date.

Revised regulations, which became effective May 1, removed restrictions upon foxes imported for breeding purposes and modified requirements for dogs, limiting inspection and quarantine to dogs intended for use in the handling of sheep or other livestock. The regulations were otherwise strengthened in order to guard more adequately against the introduction of serious diseases prevalent in many parts of both the eastern and western hemispheres.

The following tables show importations of various kinds of livestock through the different ports of entry:

*Imported animals inspected and quarantined.*

| Port of entry. | Cattle. | Sheep. | Swine. | Goats. | Horses. | Other animals. |
|---|---|---|---|---|---|---|
| New York | 816 | 3 | 1 | 6 | 119 | 783 |
| Baltimore | 135 | 43 | | | | 5 |
| Boston | 103 | | | | | |
| New Orleans | 3 | | | 3 | | 10 |
| San Francisco | | 5 | | | | 15 |
| Los Angeles | | | | | | 21 |
| Augusta | | | | | | 3 |
| Seattle | | | | | | 1 |
| Canadian border ports | 279 | 21 | 41 | | | 121 |
| Total | 1,336 | 72 | 42 | 9 | 119 | 959 |

*Imported animals inspected but not quarantined.*

| Port of entry. | Cattle. | Sheep. | Swine. | Goats. | Horses. | Other animals. |
|---|---|---|---|---|---|---|
| New York | | | | | 565 | |
| Boston | | | | | 17 | |
| San Francisco | | | | | | 882 |
| Galveston | | | | | | 1 |
| Key West | | | | | 511 | |
| San Juan | 1,936 | 4 | 129 | 2 | 182 | 6 |
| Portland, Oreg | | | | | | 11 |
| Seattle | | | | | | 100 |
| Philadelphia | | | | | 1 | |
| New Orleans | 3 | | | | 22 | 4 |
| Mexican border ports | 40,816 | 14,548 | 2,200 | 7,069 | 4,300 | 26 |
| Canadian border ports | 234,454 | 57,884 | 1,889 | 44 | 8,558 | 1,943 |
| Total | 277,209 | 72,436 | 4,218 | 7,115 | 14,156 | 2,973 |

During the year 1,617 foxes were inspected at various ports of entry and 9,123 quail from Mexico were inspected and quarantined by bureau inspectors at border ports of entry under requirements of the Bureau of Biological Survey.

Regulations effective May 1 require that cattle from countries other than Canada and Mexico be accompanied by a satisfactory tuberculin-test certificate of an official veterinarian of the National Government of origin and that a subsequent tuberculin test of such imported cattle be made by a bureau inspector at the port of entry in the United States during the last 10 days of the quarantine period.

Cattle were tested with tuberculin prior to shipment from Scotland and the Channel Islands and after arrival at quarantine stations in the United States, with the following results:

*Tuberculin tests of cattle for importation from Scotland and the Channel Islands.*

| Breed. | Tested abroad. | | | Tested in quarantine. | | |
|---|---|---|---|---|---|---|
| | Tested. | Passed. | Rejected. | Tested. | Passed. | Rejected. |
| Aberdeen-Angus | 1 | 1 | 0 | 1 | 1 | 0 |
| Ayrshire | 63 | 63 | 0 | 38 | 37 | 1 |
| Guernsey | 338 | 338 | 0 | 118 | 118 | 0 |
| Highland | | | | 42 | 42 | 0 |
| Jersey | 425 | 424 | 1 | 137 | 137 | 0 |
| Shorthorn | | | | 48 | 44 | 4 |
| Total | 827 | 826 | 1 | 384 | 379 | 5 |

Funds especially provided by Congress made possible certain needed repairs and improvements at the quarantine stations at Athenia, N. J., and Littleton, Mass., including additions to buildings at the latter station.

### IMPORTATION OF ANIMAL BY-PRODUCTS.

Supervision over the importation of animal by-products was continued under provisions of joint regulations of the Treasury Department and the Department of Agriculture. Approximately 9 per cent of hides, 15 per cent of calfskins, 35 per cent of goatskins, 20 per cent of sheepskins, and 2½ per cent of wool imported were landed subject to disinfection at destination in the United States. Disinfection of goat, sheep, and deer skins was accomplished at 74 tanneries, and hides, calfskins, and other animal by-products were forwarded and disinfected at 50 establishments throughout the country.

### INSPECTION OF ANIMALS FOR EXPORT.

The regulations designed to assure the exportation of only healthy animals and to provide for their transportation on ocean vessels in a safe and humane manner were carefully administered. The following table shows the number of animals of various kinds inspected for export shipment:

*Inspections of animals for export.*

| Kind of animals. | To Canada. | To other countries. | | Total. |
|---|---|---|---|---|
| | | American animals. | Canadian animals.[1] | |
| Cattle | 968 | 6,878 | 17,720 | 25,566 |
| Sheep | 3,889 | 6,897 | ..... | 10,786 |
| Swine | 41 | 100 | ..... | 141 |
| Goats | 49 | 21 | ..... | 70 |
| Horses | 1,173 | 2,414 | 7 | 3,594 |
| Mules | 115 | 1,940 | ..... | 2,055 |
| Total | 6,235 | 18,250 | 17,727 | 42,212 |

[1] Animals of Canadian origin exported through United States ports.

Inspection of 250 vessels carrying livestock were made before clearance.

For shipment to Canada 1,173 horses and 115 mules were tested with mallein and 968 cattle with tuberculin, with 2 reactors among the latter, and 3,889 sheep, 41 swine, and 49 goats were inspected. For shipment to other countries, including Mexico and Cuba, 36 horses and 12 mules were tested with mallein, the tuberculin test was applied to 4,194 cattle, with 35 reactors, and inspections were made of 705 sheep, 7 swine, and 43 goats.

## TICK ERADICATION DIVISION.

The Tick Eradication Division, under the direction of Dr. R. A. Ramsay, chief, continued its activities in the suppression of Texas or tick fever in cattle and the eradication of the ticks which transmit this disease. This work was carried on in cooperation with the State and county authorities in 10 Southern States.

### TICK ERADICATION.

The number of cattle inspected or dipped for the eradication of ticks, under the supervision of the cooperating forces, was greater than in any previous year, amounting to 74,937,657 inspections or dippings as compared with 48,089,005 in the fiscal year 1922. More than 31,000 dipping vats were used in the official dipping of cattle. Ten counties in Georgia were released from Federal quarantine.

In deciding on the release of territory from Federal quarantine in the past it has not been the policy to require that the area be entirely free of ticks. Many counties where a large majority of cattle and premises were tick free have been released under an agreement on the part of the State and county authorities to control and eradicate the remaining infestation. During the past year special attention was given by bureau inspectors to this final work in the released area with the view of completely eradicating the ticks from that area, and satisfactory results have been obtained in the main. In a few instances, however, it was found that following the release from Federal quarantine the local interest in completing the work had become so indifferent that instead of the remaining infestation being controlled and eradicated it had been permitted to spread. This condition made necessary the requarantine of 30 counties and 5 parts of counties in 5 States.

The following table shows the progress made in the 17 years since tick eradication was undertaken and the status of the work at the close of the fiscal year 1923. As the county is the customary unit in which the work is conducted, that unit is used in compiling the data:

*Progress of tick eradication since the beginning and status of the work June 30, 1923.*

| States. | Counties under quarantine July 1, 1906. | Counties under quarantine June 30, 1923. | Counties released to June 30, 1923. | Released counties tick free June 30, 1923. | Released counties with one or more infested herds June 30, 1923. |
|---|---|---|---|---|---|
| Alabama | 67 | 5 | 62 | 18 | 44 |
| Arkansas | 75 | 42 | 33 | 15 | 18 |
| California | 15 | 0 | 15 | 15 | 0 |
| Florida | 58 | 54 | 4 | 3 | 1 |
| Georgia | 157 | 9 | 148 | 104 | 44 |
| Kentucky | 2 | 0 | 2 | 2 | 0 |
| Louisiana | 65 | 32 | 33 | 3 | 30 |
| Mississippi | 81 | 21 | 60 | 37 | 23 |
| Missouri | 4 | 0 | 4 | 1 | 3 |
| North Carolina | 75 | 19 | 56 | 46 | 10 |
| Oklahoma | 61 | 6 | 55 | 36 | 19 |
| South Carolina | 44 | 0 | 44 | 30 | 14 |
| Tennessee | 42 | 0 | 42 | 41 | 1 |
| Texas | 199 | 90 | 109 | 42 | 67 |
| Virginia | 30 | 4 | 26 | 26 | 0 |
| 15 States | 975 | 282 | 693 | 419 | 274 |

It will be observed from the tabulation that while more than two-thirds of the counties which were tick infested have been released, less than half of the counties included in the original quarantine in 1906 can now be considered absolutely tick free, and that there are 274 counties released from Federal quarantine in which tick infestation still exists in one or more herds. The elimination of the last trace of infection in a county is frequently attended with considerable difficulty. In such areas the closest possible supervision must be given

by Federal and State employees, even to a greater extent than when the systematic dipping of cattle is first taken up in a county. For this reason released areas are sometimes again placed under Federal quarantine as a matter of economy.

### INTRODUCTION OF THE ZONE PLAN.

State livestock sanitary officials, with the possible exception of one or two States, have adopted and are putting into effect what is known as the "zone plan," recommended by the bureau as being the most effective and most satisfactory to cattle owners. This plan consists in State officials designating by law, regulation, or order certain counties or areas, contiguous to released area, in which active and systematic dipping of cattle will be required during a certain year until the work is completed in the State. It is found that in this way effort can be concentrated and tangible results obtained in minimum time. In addition it relieves county officials and cattle owners from embarrassment and constant agitation on the subject of eradicating cattle ticks. Some time during the year preceding the time when the cattle-dipping laws and regulations are to be enforced in a given zone preliminary information is carried to rural communities by means of a motion-picture outfit, equipped with a portable lighting plant, capable of showing good, clear pictures and properly illuminating rural schoolhouses. Appropriate films relating to agricultural subjects are shown, and especially films showing the life history of the cattle tick and the means found best adapted to eradicate the ticks. The motion pictures are in constant demand and seem to be very effective in bringing together practically the entire community for entertainment and recreation and at the same time conveying to cattle owners and their families some wholesome information about tick eradication and improved livestock.

### SUPPRESSING LAWLESS OPPOSITION.

The difficulties mentioned in last year's report as existing in Independence County, Ark., due to local opposition to tick eradication, have been satisfactorily adjusted, and it is expected that eradication will be finally completed in that county during the present year.

Early in the fiscal year there arose in Echols County, Ga., a condition of defiance to State laws and regulations, necessitating drastic action in providing State and Federal employees assigned to duty in that county with means of defense. In spite of these precautions one bureau employee was killed and another seriously wounded while on official duty. The Department of Justice took vigorous action, with the result that the two men alleged to be responsible for the crimes, together with 19 others more or less implicated, all of them residents of Echols County, were indicted in June by a Federal grand jury and were placed under bond for trial in the Federal court. A detailed statement of the troubles in Echols County is given in the annual report of the Georgia department of agriculture for 1922.

### SHIPMENTS FROM QUARANTINED AREAS.

The number of cattle of the quarantined area shipped under bureau supervision to market centers for immediate slaughter was 616,204. The steady decline, as compared with former years, in the

movement of this class of cattle has been brought about by the imposition by several States of more drastic restrictions governing the movement of tick-infested cattle into or through those States, and by the desire of cattle owners of the quarantined areas to avail themselves of the more profitable and unrestricted markets open to tick-free cattle, they having learned that it is feasible and profitable to ship cattle free of ticks. At public stockyards 77,795 cattle were dipped and certified for movement as noninfectious, for which 890 certificates were issued. In the field 190,022 cattle were inspected or dipped and certified for interstate movement as provided for in department regulations. To cover these shipments 2,400 certificates were issued.

## TUBERCULOSIS ERADICATION DIVISION.

The campaign for the eradication of bovine tuberculosis conducted by the Tuberculosis Eradication Division under the direction of Dr. J. A. Kiernan, chief, progressed in a highly satisfactory manner, notwithstanding a shortage of funds for the payment of indemnity and operating expenses in a number of States. Harmony and cooperation among the bureau, State, and county organizations existed to a marked degree, enabling supervising forces to lay more definite plans for the future. An effort was made, wherever conditions were favorable, to outline programs covering a number of years in advance. More active cooperation and assistance were given by the accredited practicing veterinarians, who are permitted to make official tuberculin tests. The eradication of tuberculosis from circumscribed areas continued to be the most important feature of the program, a number of additional States having taken up this project actively.

Cooperation with all of the 48 States and the Territories of Hawaii and Alaska was continued. An average of 230 regularly employed bureau veterinarians were detailed to 43 field offices of the bureau. State livestock sanitary officials maintained an average of approximately 178 such men throughout the year, while counties, cities, and farm bureaus employed an average of about 63 regular men. These figures indicate a slight decrease in the number of bureau employees, while the State forces show a slight increase and the county and local forces a marked increase.

The Federal appropriation was $850,000 for operating expenses and $2,027,600 for the payment of indemnity for animals slaughtered. The combined State appropriations totaled approximately $5,000,000. Efforts were made to conserve the funds, especially by obtaining the maximum salvage from diseased cattle slaughtered. Reports from all States indicate that considerably increased funds have been provided for the ensuing year. Counties have also made larger appropriations.

The activities were carried on under four main projects, as in recent years: (1) Eradication of tuberculosis from herds of cattle under the "accredited-herd" plan; (2) eradication of tuberculosis from circumscribed areas; (3) eradication of tuberculosis from swine; (4) control of the tuberculin testing of cattle intended for interstate shipment through supervision of the work done by practicing veterinarians on the approved list and at public stockyards.

### ACCREDITED TUBERCULOSIS-FREE HERDS.

The tuberculin testing under the accredited-herd plan, which provides for accrediting herds found free from tuberculosis on official test, was continued throughout the year. The uniform methods and rules governing this work were modified at the meeting of the United States Livestock Sanitary Association in December, 1922. The general changes as they affect the accredited-herd work are as follows:

1. Final test of any herd which showed evidence of infection on previous test shall be by a combination of recognized tests, applied at the discretion of Federal and State authorities.

2. A herd which has been removed from the accredited-herd list on account of a reactor being found may be reinstated on tests applied by accredited veterinarians in accordance with the uniform plan.

3. The payment of Federal indemnity for tuberculous cattle tested by accredited veterinarians in accordance with the uniform plan is authorized, provided that the total Federal indemnity paid for such cattle in any State shall not exceed 15 per cent of the total allotment of Federal indemnity to that State.

The effect of these amendments is to allow the participation of accredited practicing veterinarians to a much greater extent than formerly. The number of such veterinarians listed at the close of the fiscal year was 5,517. Tuberculin tests made by them are recognized as official and their work supplements that of the official veterinarians.

At the conclusion of the fiscal year there were listed as fully accredited 28,526 herds, containing 615,156 cattle, an increase of 12,310 herds and 251,254 cattle within the year. In addition to the fully accredited herds 312,281 herds containing 2,724,497 cattle passed one test as a preliminary to being accredited, an increase of 150,748 herds and 1,176,314 cattle. The total herds under supervision at the end of the year numbered 400,097, containing 4,449,722 cattle, an increase of 187,915 herds and 1,833,327 cattle. At the end of the year there were on the waiting list approximately 75,000 herds, containing about 1,000,000 cattle. In connection with this work and the area work (reported under another heading) the tuberculin test was applied to 296,138 herds, containing 3,460,849 cattle, of which 113,844 cattle, or 3.3 per cent, were condemned as diseased. The accompanying table shows by years the number of accredited herds and cattle and the number of herds and cattle that have passed one test.

*Progress of work of establishing accredited herds free of tuberculosis.*

| Fiscal year. | Cattle tested.[1] | Number of reactors. | Per cent of reactors. | Accredited. | | Passed one test. | |
|---|---|---|---|---|---|---|---|
| | | | | Herds. | Cattle. | Herds. | Cattle. |
| 1917 | 20,101 | 645 | 3.2 | | | | |
| 1918 | 134,113 | 6,514 | 4.9 | 204 | 6,945 | 883 | 22,212 |
| 1919 | 329,878 | 13,528 | 4.1 | 782 | 19,021 | 6,535 | 117,243 |
| 1920 | 700,670 | 28,709 | 4.1 | 3,370 | 82,986 | 15,599 | 197,577 |
| 1921 | 1,366,358 | 53,768 | 3.9 | 8,201 | 193,620 | 49,814 | 643,233 |
| 1922 | 2,384,236 | 82,569 | 3.5 | 16,216 | 363,902 | 161,533 | 1,548,183 |
| 1923 | 3,460,849 | 113,844 | 3.3 | 28,526 | 615,156 | 312,281 | 2,724,497 |

[1] Includes testing under area plan.

The total number of cattle tested during the seven years was 8,396,235, of which 299,607, or 3.6 per cent, reacted.

### ERADICATION OF TUBERCULOSIS FROM AREAS.

The eradication of tuberculosis from cattle within circumscribed areas, with the county as the unit, has proved to be the most effective plan so far tried. Excellent progress was made. At the close of the fiscal year one or more tests of all cattle in 81 counties had been completed, being an increase of 50 counties during the year, and 117 additional counties were actively engaged in testing cattle. The status of this work is shown by States in the following table:

*Status of tuberculosis eradication from county areas at close of fiscal year ended June 30, 1923.*

| State. | Counties having completed one or more tests of all cattle. | Counties intensively engaged in testing cattle. | Total counties engaged. | Cattle tested during year. |
|---|---|---|---|---|
| Arizona | 1 | 2 | 3 | 14,206 |
| California | | 3 | 3 | 105,302 |
| District of Columbia | 1 | | 1 | 587 |
| Idaho | 2 | 2 | 4 | 86,199 |
| Illinois | 1 | 5 | 6 | 65,445 |
| Indiana | 2 | 5 | 7 | 62,259 |
| Iowa | | 3 | 3 | 23,702 |
| Kansas [1] | | | | 13,631 |
| Kentucky | | 4 | 4 | 59,156 |
| Maine | | 12 | 12 | 51,465 |
| Maryland | 1 | | 1 | 13,357 |
| Michigan | 8 | 6 | 14 | 251,832 |
| Mississippi | 3 | | 3 | [2] |
| Missouri | 12 | 6 | 18 | 149,350 |
| Montana | 2 | 3 | 5 | 103,536 |
| Nebraska | 4 | 8 | 12 | 72,037 |
| Nevada [1] | | | | 13,323 |
| New Mexico | | 1 | 1 | 6,476 |
| New York | 2 | 12 | 14 | 159,591 |
| North Carolina | 10 | 11 | 21 | 119,114 |
| North Dakota | 1 | | 1 | 26,200 |
| Ohio [1] | | | | 4,640 |
| Oregon | 10 | 2 | 12 | 62,466 |
| Pennsylvania | 1 | 2 | 3 | 39,702 |
| Tennessee | 2 | | 2 | 37,964 |
| Utah | 1 | 3 | 4 | 27,785 |
| Virginia | 1 | 1 | 2 | 7,684 |
| Washington | 4 | 13 | 17 | 62,447 |
| West Virginia | 1 | | 1 | 10,723 |
| Wisconsin | 11 | | 11 | 90,417 |
| Wyoming | | 13 | 13 | 25,166 |
| Total | 81 | 117 | 198 | 1,765,762 |

[1] Testing reported done under community or township plan.
[2] Testing completed prior to fiscal year 1923.

The greatest advances were made by the States of California, Idaho, Illinois, Indiana, Michigan, Missouri, Montana, New York, North Carolina, Oregon, Washington, and Wisconsin. In these States machinery seems well laid for a systematic continuation. Area testing was begun in Arizona, Ohio, and Pennsylvania, while arrangements were made through State laws and appropriations to expedite the work in a number of States, including Iowa, Minnesota, and Illinois.

Emphasis has been laid on the necessity of obtaining as much assistance as possible from the counties. Such assistance has been provided in a marked degree in Michigan, Illinois, and North Carolina. In Michigan 36 counties have appropriated about $185,000,

while in North Carolina 27 counties have appropriated about $80,000, and in Illinois 34 counties have appropriated about $135,000. The money actually spent by all counties engaged in the area work increased from about $60,000 in 1922 to $133,000 in 1923.

In the District of Columbia 587 cattle were tested and 14 reactors were removed, 11 of which were in one herd known to have been previously infected and to which additions from outside the District had been made some months before the test. There were also tested for admission to the District 211 animals, from which 8 reactors were removed.

An advance step looking to future operations under the area project was taken in amending the uniform methods and rules by providing for what are termed modified accredited areas. Such an area is one in which all the cattle have been tuberculin tested under Federal and State supervision and in which the number of reactors does not exceed one-half of 1 per cent of the total cattle. The infected herds remaining are to be placed under State quarantine, and the intrastate movement of cattle into such territories is to be controlled by proper State regulations. This amendment having been approved by a majority of the States and by the bureau, arrangements were made during the last part of the fiscal year for the release of 17 counties as modified accredited areas, and an order to that effect (B. A. I. Order 283) was issued July 23, 1923. Cattle from these areas will be allowed to move interstate for a period of three years without retesting, provided proper certificates are used and the cattle are identified. The counties referred to are as follows: Dearborn County, Ind.; Hillsdale, Charlevoix, Antrim, and Emmet Counties, Mich.; Scotland, Rowan, Pender, New Hanover, Davie, Davidson, Cumberland, Cabarrus, Buncombe, and Forsyth Counties, N. C.; and Bradley and Marshall Counties, Tenn.

### STATISTICS OF SLAUGHTER AND INDEMNITY.

Statistics of the slaughter of reacting cattle, the indemnity allowed, salvage realized, etc., are given in the following table:

*Cattle slaughtered, appraised value, indemnity allowed, and salvage realized in work of tuberculosis eradication.*

| State. | Cattle slaughtered. | Average appraisal per head. | State indemnity. | Federal indemnity. | Average State indemnity per head. | Average Federal indemnity per head. | Average salvage per head. |
|---|---|---|---|---|---|---|---|
| Arizona | 777 | $92.03 | $18,551.35 | $18,551.35 | $23.88 | $23.88 | $11.03 |
| Colorado | 123 | 252.97 | 4,988.82 | 4,988.82 | 40.56 | 40.56 | 24.98 |
| Connecticut | 3,078 | 64.12 | 86,751.61 | 43,451.01 | 28.18 | 14.12 | 21.56 |
| Delaware | 1,097 | 76.39 | 35,308.22 | 22,067.20 | 32.19 | 20.12 | 13.28 |
| Florida | 268 | 28.35 | 3,684.48 | 1,930.13 | 13.75 | 7.20 | 6.70 |
| Idaho | 898 | 61.22 | 13,265.39 | 13,265.39 | 14.77 | 14.77 | 14.39 |
| Illinois | 4,288 | 91.56 | 92,489.18 | 92,489.18 | 21.57 | 21.57 | 23.73 |
| Indiana | 2,970 | 92.39 | 62,828.95 | 58,733.88 | 21.15 | 19.78 | 21.80 |
| Iowa | 7,824 | 100.23 | 187,551.40 | 176,973.23 | 23.97 | 22.62 | 21.10 |
| Kansas [1] | 551 | 106.09 | 30,079.18 | 11,610.60 | 54.59 | 21.07 | 20.91 |
| Kentucky | 1,242 | 72.00 | 47,457.75 | 19,665.89 | 38.21 | 15.83 | 15.21 |
| Maine [1] | 695 | 89.55 | 39,403.70 | 14,383.03 | 56.70 | 20.70 | 11.88 |
| Maryland | 3,531 | 82.09 | 74,834.84 | 74,767.43 | 21.19 | 21.17 | 17.77 |
| Massachusetts | 1,715 | 145.09 | 53,007.29 | 52,557.01 | 30.91 | 30.65 | 20.17 |
| Michigan | 2,200 | 78.67 | 82,071.20 | 38,198.46 | 37.31 | 17.36 | 18.71 |
| Minnesota | 1,811 | 56.16 | 40,995.42 | 20,430.76 | 22.64 | 11.28 | 21.94 |
| Mississippi | 14 | 67.50 | 549.95 | 281.45 | 39.28 | 20.10 | 7.19 |
| Missouri | 1,406 | 118.68 | 33,569.64 | 33,569.64 | 23.88 | 23.88 | 26.05 |
| Montana [1] | 604 | 46.63 | 19,198.41 | 7,798.84 | 31.79 | 12.91 | 4.54 |

[1] Salvage paid to State.

*Cattle slaughtered, appraised value, indemnity allowed, etc.*—Continued.

| State. | Cattle slaughtered. | Average appraisal per head. | State indemnity. | Federal indemnity. | Average State indemnity per head. | Average Federal indemnity per head. | Average salvage per head. |
|---|---|---|---|---|---|---|---|
| Nebraska | 855 | $92.61 | $17,604.01 | $17,604.01 | $20.59 | $20.59 | $24.66 |
| Nevada | 157 | 71.40 | 5,396.63 | 3,632.26 | 34.37 | 23.14 | 13.03 |
| New Hampshire | 1,567 | 73.91 | 49,648.82 | 28,932.94 | 31.68 | 18.46 | 18.01 |
| New Jersey | 1,808 | 154.60 | 77,626.31 | 56,268.51 | 42.93 | 31.12 | 21.18 |
| New Mexico | 19 | 56.71 | 359.15 | 359.15 | 18.90 | 18.90 | ..... |
| New York | 7,576 | 142.84 | 671,902.26 | 193,253.24 | 88.69 | 25.51 | 17.50 |
| North Carolina | 593 | 80.44 | 11,123.53 | 11,123.53 | 18.76 | 18.76 | 14.03 |
| North Dakota | 1,204 | 39.88 | 9,360.94 | 9,360.94 | 7.77 | 7.77 | 17.99 |
| Ohio | 1,694 | 114.56 | 48,259.68 | 48,259.68 | 28.49 | 28.49 | 24.98 |
| Oklahoma | 177 | 133.62 | 9,589.09 | 5,253.76 | 54.18 | 29.68 | 19.17 |
| Oregon | 1,380 | 95.92 | 30,483.00 | 30,424.09 | 22.09 | 22.05 | 16.58 |
| Pennsylvania | 2,647 | 122.16 | 110,527.33 | 72,011.81 | 41.76 | 27.21 | 12.64 |
| Rhode Island | 54 | 178.80 | 3,304.50 | 1,655.97 | 61.19 | 30.67 | 29.39 |
| South Carolina | 108 | 66.74 | 1,922.66 | 1,912.66 | 17.80 | 17.71 | 14.87 |
| South Dakota | 830 | 95.96 | 28,592.52 | 17,303.06 | 34.45 | 20.85 | 21.85 |
| Texas | 252 | 176.59 | 7,755.95 | 7,755.95 | 30.78 | 30.78 | 16.23 |
| Utah | 367 | 73.16 | 7,720.85 | 7,553.16 | 21.04 | 20.58 | 10.00 |
| Vermont | 3,124 | 81.96 | 72,563.49 | 72,563.49 | 23.23 | 23.23 | 11.70 |
| Virginia | 509 | 94.04 | 12,309.99 | 9,927.64 | 24.18 | 19.50 | 13.85 |
| Washington | 1,023 | 109.58 | 25,294.76 | 25,294.76 | 24.73 | 24.73 | 19.80 |
| West Virginia | 524 | 98.79 | 28,997.10 | 13,630.90 | 55.34 | 26.01 | 13.50 |
| Wisconsin | 5,992 | 102.92 | 113,701.93 | 113,674.01 | 18.98 | 18.97 | 17.90 |
| Wyoming | 250 | 81.65 | 3,817.86 | 3,167.80 | 15.27 | 12.67 | 10.41 |
| Total | 67,802 | 98.94 | 2,274,449.14 | 1,456,636.52 | 33.55 | 21.48 | 18.57 |

### ERADICATION OF TUBERCULOSIS FROM SWINE.

Attention has been given in practically every State in which the swine industry exists to tracing the sources of infection of swine with tuberculosis. Frequent tests of known infected herds of swine have been made with good results. It is believed that the area eradication work among cattle will eventually eliminate tuberculosis from swine, as the greatest source of infection in swine is known to be through following diseased cattle or drinking unpasteurized skim milk from creameries. Continued attention is being given to publicity regarding modes of infection and means of prevention, with such tuberculin testing as is deemed advisable in the breeding stock.

### REGULATION OF INTERSTATE MOVEMENT.

Regulation 7 of B. A. I. Order 273, governing the interstate movement of cattle so far as tuberculosis is involved, has worked smoothly. The 8,389 veterinary practitioners authorized to make tuberculin tests of cattle for interstate shipment tested for that purpose 199,789 cattle, of which 2,443, or 1.2 per cent, reacted. Regularly employed bureau inspectors tested at public stockyards 37,801 cattle, from which there were removed 601 reactors, or 1.6 per cent.

Permits were issued for the interstate movement of 34,232 known reactors for immediate slaughter and for 12 animals which were returned to the original owners for breeding purposes.

### TUBERCULIN TESTING.

Advantage was taken of the large number of tuberculin tests of cattle (3,460,849) to gather and study data as to the results with the various tests and combinations so as to enable the veterinarians to improve their knowledge of the subject and to standardize methods throughout the service. Statistics of tests by the various methods are

as follows: Subcutaneous method, 129,058 cattle, with 8,238 reactors, or 6.4 per cent; intradermic method, 2,689,313 cattle, with 70,718 reactors, or 2.6 per cent; ophthalmic method, 1,593 cattle, with 59 reactors, or 3.7 per cent; combination tests, 572,883 cattle, with 32,598 reactors, or 5.7 per cent. The intradermic test has largely superseded the others because of its economy and practicability for area work.

About 47 per cent of the tests were made by bureau inspectors and about 53 per cent by the State and county men and the accredited practitioners.

Information regarding the occurrence of tuberculosis in calves was obtained by compiling figures of results of the testing of calves in herds subjected to the tuberculin test. Among 66,504 calves under 1 year of age there were 2,390 reactors, or 3.6 per cent. The percentage of reactors among calves under 6 months of age was 2.6, while among those from 6 months to 1 year old it was 4.3.

A study of delayed reactions (at and after the seventy-second hour following injection of tuberculin) indicated that in the intradermic test observations should be made in every case at the seventy-second hour, and in nearly all cases where infection is disclosed in the herd another observation should be made between the one hundred and twentieth and the one hundred and fiftieth hours.

Department Circular 249, The Tuberculin Testing of Livestock, published during the year, was widely distributed among veterinarians and has helped to set a standard for the application of the various tests and their combinations.

Close supervision was again given to the slaughter of reacting cattle with a view to investigating the cases in which no visible lesions of tuberculosis were found on post-mortem examination. It is significant that nearly three-fourths of such cases were from herds in which infection was found. Of 107,250 reactors slaughtered, 17.3 per cent were classified as undoubted spreaders of the disease, and 13.3 per cent of the carcasses were either condemned as unfit for food or sterilized.

An endeavor has been made to conserve funds by systematizing the work and grouping the herds or confining the activities to circumscribed areas so as to reduce the cost of testing per head. The average cost of testing by bureau inspectors, including salaries and expenses of field veterinarians, but not office expenses or salaries of supervising officers, was 35 cents a head, as compared with 46 cents during the preceding year and 57 cents the year before.

### SEGREGATION NOT WIDELY USED.

Information was collected through bureau stations as to the extent to which cattle which have reacted to the tuberculin test are being held as segregated herds in the United States. This system involves retaining for breeding purposes tuberculous animals of high breeding value instead of slaughtering them. By separating the calves from their dams and pasteurizing the milk before feeding it to them an effort is made to raise healthy offspring. The bureau was able to learn of only 201 such herds, containing 2,461 cattle, which were being permanently maintained for breeding purposes, and about two-thirds of these herds were in six States in which tuberculosis in livestock exists rather extensively. In 18 States no quarantined diseased herds were being maintained. It is evident that the more direct and

effective methods of eradication are regarded as more practicable and find greater favor in this country.

#### CONFERENCES AND PUBLICITY ON TUBERCULOSIS ERADICATION.

One major conference on tuberculosis was held at Concord, N. H., June 12 and 13, 1923, and was attended by bureau and State officials, practicing veterinarians, livestock owners, representatives of breeders' associations, public health officials, county agents, and others. Numerous State and other local meetings of veterinarians were attended by representatives of the tuberculosis eradication division.

Farmers' Bulletin 1069, Tuberculosis in Livestock, was revised during the year, and its distribution is being continued as a means of giving information on this subject and arousing interest in tuberculosis eradication.

Circulars, entitled Sidelights on Tuberculosis, were issued at irregular intervals and were distributed to veterinarians actively engaged in tuberculosis eradication.

Numerous other articles relative to tuberculosis eradication were prepared in the division and published in livestock and veterinary periodicals.

### DIVISION OF HOG-CHOLERA CONTROL.

Efforts to control losses from hog cholera and to reduce the number of outbreaks and centers of infection were continued through the Division of Hog-Cholera Control, under Dr. U. G. Houck, chief.

From reports gathered in the field the percentage of hogs destroyed by cholera was indicated to be about 80 per cent of all hogs killed by diseases of all kinds. On that basis the mortality rate in swine due to hog cholera was 40.5 per 1,000, a reduction of 8.2 per 1,000 from the rate of the year before. The number of hogs on farms January 1, 1923, was 63,424,000, according to data gathered by the the Bureau of Agricultural Economics, at an average valuation of $11.46 a head. During the year ended April 30, 1923, there were destroyed by hog cholera 2,564,837 hogs, which, at the valuation mentioned, made a total monetary loss of $29,393,032 from the disease. These figures show the necessity for continued efforts to control and reduce the still serious ravages of hog cholera.

Approximately 80 veterinarians were maintained in the field up to March 1, 1923. A considerable reduction in the appropriation for 1924 made it necessary for the division to reorganize its force and reduce the number of men to conform with the funds available July 1, 1923, and to curtail and consolidate its activities in some States. By the end of the fiscal year the force was reduced to about 47 inspectors.

Bureau inspectors continued to assist practicing veterinarians in the diagnosis of swine diseases and in the technic of serum administration. In sections where veterinary services were not readily available they performed the inoculation of hogs. Advice and information were given to swine growers as to the methods of preventing infection and cleaning and disinfecting premises.

Cooperation on the part of State officials and educational forces in general was quite satisfactory. County agents and other extension workers lent their assistance in reporting outbreaks of cholera and conducting educational work. It is regrettable, however, that many

farmers do not take prompt action in calling for assistance when trouble appears in their swine herds. Too often there is a long delay from the time the hogs sicken until trained assistance is sought, and in many cases when cholera is present the disease has advanced to such a stage when the inspector reaches the outbreak that many hogs are dead or beyond receiving benefit from the serum treatment.

The year had the usual quota of misguided information, incorrect diagnoses, and improper methods of handling outbreaks of cholera. "Breaks," or the recurrence of hog cholera in herds supposed to have been immunized against the disease, continued to give some trouble. While special attention was given to these breaks, in many cases no positive causes could be determined as being wholly responsible for the return of susceptibility in the herds. In other cases bureau inspectors were able to trace the unfavorable results to nonvirulent or attenuated virus, underdose of either serum or virus, and improper care of the animals following inoculation.

In the course of the year bureau veterinarians held or attended 1,418 meetings, at which there was an attendance of 84,896 persons, and 4,855 demonstrations in the use of serum and virus were given, in which 108,472 hogs were treated before 21,547 persons interested in the control of hog cholera. Investigations were made on 51,306 premises, 5,182 autopsies were held and cholera was diagnosed in 4,081 cases, and 1,632 farms were quarantined. Interviews to the number of 183,545 were had with farmers, swine growers, veterinarians, merchants, bankers, and others interested in the control of hog-cholera losses; practicing veterinarians were assisted in treating 892 herds containing 34,820 hogs. There were reported during the year from all sources 7,074 outbreaks of hog cholera.

## PATHOLOGICAL DIVISION.

The Pathological Division, under the direction of Dr. John S. Buckley, chief, has continued the investigation of animal diseases and factors connected with the control of disease.

A great many specimens have been examined throughout the year for the purpose of diagnosis, and while in a measure they have hampered research studies, they have also furnished clues that have advanced our knowledge of special diseases.

### RESEARCH ON DISEASE PROBLEMS.

#### BOVINE INFECTIOUS ABORTION.

In studying the value of biological products in combating infectious abortion of cattle, a practice has commonly been made of estimating their action by considering the calving or abortion records of treated subjects. During the last year the problem was attacked in a somewhat different manner. An experiment was undertaken with the object of ascertaining whether, by repeated injections of abortion bacterin (suspensions of killed abortion bacteria), the multiplication of abortion microorganisms in the udders of affected animals could be overcome.

Seven cows which eliminated *Bacterium abortus* in their milk were given 6 subcutaneous injections of abortion bacterin at weekly intervals, while 8 cows which also eliminated the organism were

held as untreated controls. The milk of all these cows was tested for the presence or absence of the organisms after the lapse of approximately 2 months, 4 months, 6 months, and 11 months. Five of the treated animals and five of the controls were still carriers of the microorganism when the last test was made. The 15 cows produced 10 seemingly healthy calves. Four were dropped by the treated group of 7, and 6 by the control group of 8. One treated subject and one control aborted, and the abortion organism was isolated from the fetuses. Gestation periods of the 3 remaining animals are incomplete.

While these results reveal no information as to what bacterin injections may accomplish in the treatment of abortion-free subjects, they furnish a certain amount of evidence that carriers of the infection derive little or no benefit from bacterin therapy. The fact that 5 of the 8 cows which received no treatment produced healthy calves, although the infection persisted in their udders, indicates, as has frequently been observed, that animals may become tolerant to the microorganisms to a marked degree and may readily yield misleading data as to the value of any remedial agents that may be employed if the methods of evaluation are not carefully controlled.

The agglutination test was applied to approximately 1,500 samples of bovine blood serum as a means of more definitely determining the cause of abortion losses in numerous herds or ascertaining to what extent the disease had become disseminated. Correspondence furnished a means of acquainting many stock owners with information for combating the disease.

#### RABIES.

As two Japanese investigators reported favorable results in the control of rabies by a single injection of a vaccine composed of fixed rabies virus that had been attenuated, and as this subject has considerable importance from both economic and public-health standpoints, experiments were undertaken by the Pathological Division to determine the value of this method of immunization in dogs. While the work is not complete, sufficient evidence has been obtained to show that this method fails to protect dogs against an artificial exposure with street virus obtained in Washington, D. C. Some protection was afforded to dogs exposed to a certain virus from another source. The studies are being continued.

#### FEEDING MOLDS TO ANIMALS.

In cooperation with the Bureau of Chemistry, experiments were undertaken to determine the effect of feeding oats infected with various molds to horses and sheep. Oats infected with pure cultures of *Aspergillus flavus*, *A. fumigatus*, and *A. tumari* have been fed for a period of 6 weeks each without causing any apparent ill effects. The experiments are being continued with other molds.

### DIAGNOSIS OF DISEASES.

#### RABIES.

Specimens from 144 suspected cases of rabies were submitted for examination, with positive results in 91 cases, comprising 78 dogs,

6 cats, 4 cattle, and 3 hogs. The rabid animals were said to have bitten or scratched 72 persons, 2 cows, 1 horse, and 19 dogs. Most of the specimens came from the District of Columbia, although Virginia, West Virginia, and Maryland contributed a goodly share. The number of positive cases was 35 more than in the preceding year. In April, May, and June 55 cases of rabies were diagnosed, and of these 23 occurred in the District of Columbia, where dogs are not muzzled during those months of the year.

### TUBERCULOSIS.

Specimen tissues taken from 476 cattle which had reacted to the tuberculin test but had shown no visible lesions of tuberculosis on autopsy were examined microscopically, and 88 of the samples were found to contain organizations having the characteristics of tubercle bacilli. Of the total number of samples 435 were lymph glands, in 65 of which the organisms were found. There were 27 samples of skin lesions, of which the organisms were found in 21. In addition tissues from 20 calves, ranging from 2 days to 3 weeks in age, were examined, and 17 proved to be tuberculous.

A calf belonging to a tuberculosis-free herd reacted to the intradermic tuberculin test. No source of bovine infection could be found, and it was suspected that the animal might have acquired the disease from a caretaker who was thought to be suffering from advanced pulmonary tuberculosis. The calf was slaughtered and at autopsy a small, pea-sized nodule containing dry, gritty material was found in one of the mesenteric lymph nodes. In this lesion were found many acid-fast organisms which were proved by animal inoculation and culture tests to be typical tubercle bacilli of the human type.

### GLANDERS.

Cooperative work in the control and eradication of glanders in the various States was continued. The complement-fixation test was applied to 237 samples of serum from animals suspected of being affected with or exposed to glanders, and 23 gave positive reactions.

### DOURINE.

In the course of the campaign for the control and eradication of dourine 11,530 samples of blood serum from horses in districts where dourine exists or is suspected to exist were subjected to the complement-fixation test for that disease. Three hundred and sixty-four of the samples, or approximately 3 per cent, gave positive reactions.

### TESTING ANIMALS FOR IMPORT.

Blood serum from 174 animals offered for import, including 50 Army horses returned from overseas duty in Germany, were subjected to the complement-fixation test for glanders and trypanosomiasis.

In a lot of 15 dromedaries offered for import, 5 were found to be affected with trypanosomiasis. Work on the identity of the trypanosome is still in progress, but there are indications that the organism is of the type that produces surra, a disease of high mortality and one which does not exist in this country. All the affected animals were destroyed. The remainder are being held in quar-

antine until their freedom from trypanosomiasis is definitely established.

The discovery of trypanosomiasis in this importation of camels emphasizes the importance of the bureau's quarantine and laboratory service in keeping out of this country diseases such as surra, which, if it gains a foothold, is likely to cause inestimable losses to the livestock industry.

### AUTOPSIES ON WILD ANIMALS.

The carcasses of 27 birds and 33 mammals were received from the National Zoological Park for post-mortem examination. Of the birds, 3 were affected with aspergillosis, 2 with tuberculosis, 1 with congestion of the lungs, 6 with enteritis, 2 with gastritis, 1 with gastroenteritis, 1 with lead poisoning, and 11 with undetermined affections. Of the mammals, 4 were affected with tuberculosis, 2 with anemia, 4 with enteritis, 1 with gastritis, 4 with gastroenteritis, 1 with goiter, 2 with internal hemorrhage, 9 with necrobacillosis, 2 with pneumonia, 1 with pleurisy, 1 with pyemia, and 2 with disseminated tumors.

An affection commonly called jaw disease has existed for some time among the kangaroos kept at the National Zoological Park. This year the disease appeared in particularly virulent form and 9 animals died. A study of these cases revealed the presence of *Actinomyces necrophorus* in all of them and led to a diagnosis of necrobacillosis.

### TESTING BIOLOGICAL PRODUCTS.

The testing of commercial veterinary biological products prepared under Government licenses, as well as of the cultures from which they were prepared, has been continued, with samples submitted through the Division of Virus-Serum Control, in connection with the enforcement of the virus-serum-toxin law. Samples of 47 products were examined, of which 9 were found to be unsatisfactory by reason of lack of potency or contamination. There were also examined 141 cultures, of which 15 were found to be unsatisfactory.

### INVESTIGATION OF POISONOUS PLANTS.

Investigations of poisonous plants and their effects on livestock have been continued along the same general line as in the last few years. The field experiments have been carried on almost entirely at the experiment station on the Fishlake-Fillmore National Forest, near Salina, Utah. It has been shown to be entirely feasible to use in feeding experiments at this place dried plant material from other localities, in addition to the plants which are available in the immediate vicinity.

An investigation of losses from eating lupine on the Glenwood division of the Fillmore National Forest was made in the summer of 1922, and a survey of a poison area in the Weiser National Forest was made in the spring of 1923. In the latter case there seemed to be no doubt that the loss was caused by wild cherry and death camas, and was occasioned by the fact that the sheep were obliged to pass over a driveway where there was little to eat except these injurious plants.

The woolly-pod milkweed, *Asclepias ericarpa*, growing in California, has been shown to be very poisonous, and its characteristics have

been worked out. Department Circular 272, giving results in popular form, has been issued, and a technical bulletin has been prepared.

Two loco plants, *Astragalus notoxys* and *Astragalus wootoni*, in addition to others previously investigated, were shown to be poisonous.

Preliminary work was done toward determining which species of lupine are poisonous and to what extent and which are harmless. A detailed chemical study of several species is under way.

The possibility of poisoning by greasewood (*Sarcobatus vermiculatus*) has been demonstrated experimentally, and it has been shown that the poisoning is caused by the oxalates of sodium and potassium in the plant. Some questions remain to be cleared up in regard to losses under range conditions.

Chemical investigations to identify and isolate the poisonous principles of stock-poisoning plants have been continued. Alkaloids have been isolated from some of the lupines. In an extended investigation of white snakeroot (*Eupatorium urticæfolium*) enough information has been obtained to give a fairly good idea as to the chemical relationships of the toxic principle. Experiments on sheep with extracts of this plant leave no room for doubt as to the decided toxicity of the plant.

### BRANCH LABORATORIES.

The work of the branch pathological laboratory at Chicago consisted largely of making diagnoses of pathological conditions encountered in meat inspection.

In view of the large increase in the slaughter of cattle which have reacted to tuberculin and the failure to find visible lesions of tuberculosis at autopsy in many cases, an experiment on 12 cattle was carried out to throw light on this condition. The results indicated that cattle after exposure to tuberculous infection become sensitive to tuberculin and react to the test before lesions of sufficient size to be seen on autopsy have developed.

In an experiment to test the possibility that some of the tuberculous lesions found in and beneath the skin of cattle might be caused by tubercle bacilli of the avian type, 7 chickens tested with avian tuberculin and found to be free from tuberculosis were allowed to feed on tuberculous lesions of the skin in 113 cattle during a period of five months, but autopsy showed that infection had not been transmitted.

The branch laboratory at Omaha, Nebr., received 921 specimen tissues for diagnosis and study, of which 696 were from tuberculin reactors showing no lesions. The remaining specimens represented a wide variety of diseases and conditions.

The branch laboratory at Denver, Colo., received 783 specimens for examination. Besides aiding the meat inspection, cooperation was extended to the city and State health departments and to veterinarians and stockmen.

## BIOCHEMIC DIVISION.

The work of the Biochemic Division, under Dr. M. Dorset, chief, consisted chiefly of laboratory research relative to meat products, investigations concerning hog cholera, studies of dips, disinfectants, and insecticides, and the preparation of tuberculin and mallein.

### INVESTIGATIONS OF MEATS AND MEAT FOOD PRODUCTS.

The investigations relating to the nutritive value of meats and meat food products have been continued, particular attention being given to the vitamin content of the muscle tissue of beef, pork, and mutton, with an extension of the work to include the meat and eggs of several species of fowl. A part of this work has been conducted in cooperation with the Animal Husbandry Division.

#### VITAMIN CONTENT OF PORK, BEEF, AND MUTTON.

Further studies in extension of the work reported in Department Bulletin 1138 confirmed the results there reported and showed that hog muscle is relatively rich in the antineuritic vitamin (vitamin B). For example, 5 per cent of dried hog muscle, corresponding to 3.4 per cent of fat-free muscle, protected a pen of 4 pigeons against polyneuritis for 8 weeks, while 5 per cent of one lot of baker's dried yeast or 4 per cent of one lot of brewer's yeast which were tested at the same time failed to protect the pigeons.

A study was made of the vitamin A content of the lean meat and of the fat rendered from the fatty tissues of the best grades of beef, pork, and mutton purchased on the local market, but had not been completed at the end of the year.

#### VITAMIN B IN POULTRY FLESH AND EGGS.

A study of vitamin B (antineuritic vitamin) in poultry flesh and eggs resulted in finding that, in the samples tested, the lean flesh of frying chickens and of hens and turkeys was relatively deficient in this vitamin. The guinea-hen flesh seemed to have a slightly higher value, while the duck flesh contained a fairly large proportion of the vitamin. Hen's eggs did not appear to contain a very large amount of the vitamin, although they have been generally considered by other workers to be fairly rich in it. The tests were all conducted on pigeons. A few tests with white rats to determine the value of eggs as a source of vitamin B for growth indicated that while the samples examined possessed a certain proportion of that vitamin, they apparently did not rank high in that respect. The white of the egg appeared to contain no vitamin B, the entire amount being contained in the yolk.

#### VITAMIN A IN POULTRY FLESH AND EGGS.

A study was also made of the vitamin A content of the same lots of poultry flesh and eggs which served for vitamin B determinations, and in addition samples of rendered fat from several lots of poultry were also tested for vitamin A. These studies were all carried out by feeding young white rats. The findings were that the lots of poultry flesh and poultry fat studied contained a fair proportion of vitamin A, while hen's eggs were very rich in it, the yolk containing the entire quantity.

#### EFFECT OF VITAMINS ON GROWTH.

In addition to the previously described work several projects relating to the effect of vitamins on the growth and development of animals were begun, in cooperation with the Animal Husbandry Division. The first embraces a study of the effect of the vitamin

content of the diet of hens upon the yield, fertility, hatchability, and vitamin content of the eggs. A second project involves a study of the effect of the vitamin content of the diet upon the development of pigs and upon the vitamin content of their tissues.

### THE RANCIDITY OF FATS.

Further progress was made in the study of the rancidity of fats. Some of the results were published in the Journal of Engineering Chemistry, January, 1923, and another paper giving additional results has been prepared.

### EMACIATION IN CATTLE.

A continuation of the chemical study of emaciation in cattle has confirmed the previous conclusion that there are clear-cut differences in the composition of the flesh of cattle condemned for emaciation and that of normal cattle passed for food. Work has been hampered by the difficulty in getting suitable carcasses for investigation, but progress is being made toward finding an accurate chemical means of judging in connection with post-mortem findings in meat inspection whether a certain carcass should be condemned for emaciation or passed for food.

### DIPS AND DISINFECTANTS.

During the calendar year 1922 there were sent out to inspectors in the field for testing the strength of dipping baths 1,912 new test outfits for arsenical dips and supplies sufficient to make 962,000 field tests; 32 new test outfits for lime-sulphur dips and sufficient supplies to make 21,000 tests; and 3 new outfits for testing nicotin dips and supplies sufficient to make 2,925 tests. The total number of tests for which supplies have been furnished was practically double that for the preceding year.

Studies with a view to improving the saponified cresol solution which is used principally for official disinfection were continued. It has been found that the soap used in compounding such disinfectants is of great influence upon the bactericidal properties of the disinfectant. When certain kinds of soap are used without change in the cresol the germicidal efficiency of the finished disinfectant may be enhanced several hundred per cent against certain bacteria. The cause of these differences in bactericidal power has been traced to the particular fatty acids present in the soap, and it has even been found that the soap used alone entirely without cresol is in itself a decidedly powerful disinfectant against certain microorganisms. As these powerful soaps may be readily and cheaply obtained, it is believed that the results of the investigations will have much practical value.

Some advance has been made in the investigation of the mode of action of those classes of disinfectants which do not appear to enter into definite chemical combinations with the substance of the bacteria, such as, for example, phenols and soaps. The hypothesis advanced last year that differences in effectiveness are parallel to certain physical differences has been confirmed.

The study of colloidal phenomena which was referred to in the preceding year's report has been continued. The subject is complex.

The literature is voluminous and there is a lack of agreement among the various writers with respect to the precise mechanism of colloidal phenomena. In view of the somewhat unsettled condition in this field, it was decided to abandon the idea of a study of colloidal reactions in general as originally planned, and to concentrate upon intensive study in narrower fields in order to develop the various principles and their particular application one at a time.

### HOG-CHOLERA INVESTIGATIONS.

In continuation of investigations on hog cholera, much attention has been given to the immunization of suckling pigs by the simultaneous method. It is evident that if all pigs could be successfully immunized when very young many advantages would accrue. In order to determine whether or not the immunity following the simultaneous immunization of young pigs is actually of short duration, or whether it may be expected to last as well as when the same treatment is given to older pigs, arrangements have been made with the Animal Husbandry Division to immunize all of the young pigs produced at the various experimental farms under the control of that division. Nearly 3,000 pigs have been treated during the suckling period without any loss from treatment and so far without the discovery of susceptible pigs among those that were tested from three to six months after treatment. It is too early to announce final conclusions. The tests are being continued.

A study of the causes which are responsible for the so-called breaks in immunity following simultaneous immunization has been continued. Careful experiments repeated and carried out on a large number of hogs have shown that hog-cholera virus of good potency may be expected to produce disease when injected subcutaneously in doses of one three-hundred thousandth of a cubic centimeter. This fact alone seems to indicate that the failure to obtain immunity after simultaneous inoculation in some cases is probably not due to the employment of too small a dose of virus but rather to some defect in the quality of the virus. A few cases have again come to notice where there was a failure to preserve the virus properly, but a systematic examination of the virus produced during the course of regular business by licensed establishments has resulted in the finding of a very satisfactory and uniform virulence. It is quite possible, however, that in practice when hog-cholera virus is sent from the producing plant to local supply depots or to local jobbers, or even to veterinarians, it is not kept under the best possible conditions. The effect of temperature and other factors upon commercial virus is therefore being studied.

A study of the relation of *Bacillus suipestifer* to hog cholera as it occurs naturally and to the breaks in immunity which are observed from time to time in immunized herds was continued and two technical papers reporting results were published.

The Biochemic Division produced about 50,000 cubic centimeters of anti-hog-cholera serum for use in the various experiments and also the virus required. Tests were made frequently of particular samples of serum or virus alleged to be contaminated or worthless, usually forwarded by the Division of Virus-Serum Control. Two such lots of old defibrinated blood serum were tested, and both appeared to be of undiminished potency. One sample of clear serum

made in 1917 and five years old at the time of test was found to retain its potency in like degree.

The chemical studies of hog-cholera serum have progressed, and some of the work has been reported in technical papers.

### HOG "FLU" AND NECROTIC ENTERITIS.

The study of hog "flu" was continued, and a summary of the information obtained was published. It has not been possible to identify the causative agent in this disease. The opportunity was presented to study a natural outbreak on a farm not far removed from the bureau-station premises. Healthy pigs carried to the farm and exposed to others sick at the time with "flu" contracted mild cases of the disease. Efforts were made to infect healthy pigs by artificial means, but in no instance was it possible to set up a disease as severe as that which existed naturally on the farm under study.

The peculiar, severe intestinal inflammation commonly known as necrotic enteritis has been studied in the field as the opportunity presented itself. The bureau's investigators have not been able to reproduce this disease by injection of blood from affected animals and have in only a few instances succeeded in reproducing it by the feeding of diseased tissues. It has not been possible to reproduce the disease by the use of the microorganisms isolated from sick pigs. This work will be continued.

### TUBERCULIN AND MALLEIN.

The production of both tuberculin and mallein was continued throughout the year. The demand for mallein has been small, the total amount supplied to bureau inspectors being only 24,775 doses. The demand for tuberculin, however, has continued, although there is evidence of the gradual substitution of the intradermic and ophthalmic tests for the subcutaneous test. The year's output, which was supplied mostly to bureau inspectors, but also to State and local officials, was as follows: Subcutaneous tuberculin, 1,819,080 cubic centimeters, a decline of about 26 per cent from the preceding year; intradermic tuberculin, 5,794,235 doses, an increase of more than 12 per cent; ophthalmic tuberculin, 1,577,880 disks, an increase of approximately 13 per cent. The solution of the mechanical difficulties encountered in preparing ophthalmic tuberculin disks has enabled the division to meet the extraordinary demand which has developed during the past two years.

An investigation of the factors which influence the growth of tubercle bacilli on artificial media was begun.

### COOPERATION WITH INSECTICIDE AND FUNGICIDE BOARD.

The routine examination of samples for the Insecticide and Fungicide Board was continued and certain investigative work was undertaken.

## ZOOLOGICAL DIVISION.

The investigation of parasitic diseases of animals and the study, collection, and determination of animal parasites have been continued in the Zoological Division under the direction of Dr. B. H. Ransom, chief.

### ROUNDWORMS AND OTHER INTERNAL PARASITES OF SHEEP.

Further experiments at the Government sheep farm at Vienna, Va., confirm previous experience as to the efficacy, against stomach worms, of the 1 per cent copper sulphate solution administered in single or repeated doses. The results indicate that the eradication of stomach worms from sheep and pastures by this method is possible, though it may be difficult as a practical matter owing to traffic in sheep under actual farming conditions. Without attaining complete eradication, however, the treatment may be used to reduce the number of worms to a point where the growth of the sheep and the yield of wool will not be interefered with and losses will be avoided. The treatment with copper sulphate is described in Farmers' Bulletin 1330, Parasites and Parasitic Diseases of Sheep. Infestation with stomach worms has been purposely maintained on the Government farm so that experiments may be continued.

The thread-necked roundworms, species of Nematodirus, appear to be distinctly injurious parasites, although not so important as the stomach worm. Hookworms, formerly present on the experiment farm, were not found during the year; apparently they are more readily controlled by the measures used than are stomach worms. Nodular worms are also less abundant than formerly and likewise appear susceptible to some degree of control by the measures used. The small intestinal trichostrongyles are still present.

Observations at slaughterhouses indicate that when tapeworms are present in a flock of sheep there is commonly a 100 per cent infestation. In the experiment flocks treated with copper sulphate the number of animals infested with tapeworms continually diminishes. In two flocks of the same age and breeding, one treated and one not treated, tapeworms were more prevalent in the untreated animals. The injury to sheep from tapeworms appears to be slight compared with that due to roundworms.

Many farmers prefer lambing in April, but there is general complaint that these late lambs do not do so well as earlier ones. For various reasons, such as market conditions, avoidance of parasites, etc., there are advantages in lambing in January and February. These early lambs may be marketed before treatment for parasites is necessary. The ewe lambs to be kept, however, must be treated, but with their rapid early growth subsequent treatment is easy. As a part of a test to determine the most favorable lambing season in relation to parasitism, the 1923 lamb crop at the Vienna farm was dropped in March for the most part. These lambs did well and most of them were in marketable condition in August.

As an extension of the work at the Vienna farm, some field experiments on the control of stomach worms were begun in Schuyler County, Mo., in October, 1922. Ten farms were selected, the owners agreeing to the plans and offering their full cooperation in carrying out dosing of their flocks once a month with a 1 per cent solution of copper sulphate for the purpose of studying the effects of this treatment on stomach worms under practical farm conditions. The work was begun with 1,200 sheep, which received monthly treatment throughout the autumn, winter, and spring. Including the 1923 lamb crop and one more farm flock which was added in June, 1923, more than 2,000 sheep were under supervision in the experimental

work at the end of the fiscal year. This work well supports the conclusions reached in prior experiments. All of the cooperating owners are highly pleased with the noticeably beneficial results to their flocks.

### ROUNDWORMS OF HOGS.

The work in McLean County, Ill., consisting of observations on a working system of swine sanitation devised in the Zoological Division for the control of roundworms, has been continued with excellent results. Approximately 9,000 pigs, the property of 31 farmers, were under observation during the year.

Developments of late years have emphasized the great susceptibility of young animals to parasitism and the seriousness of parasitism among young livestock. The bureau has taken the initial steps in bringing these facts to the attention of veterinarians and livestock owners and is planning to obtain wider recognition of the great importance of preventing the widespread losses from infant mortality among livestock. The possibility of preventing some of these losses by sanitary measures has been effectively demonstrated in the use of a sanitary system for raising swine.

Experiments to determine the length of time that infective ascarid eggs will persist in soil have been carried out at Chicago, where it was found that live, active worm embryos were present in eggs buried in soil for 375 days, indicating that soil infection will persist for more than a year. This experiment is being continued.

Experiments to determine the value of certain substances as disinfectants indicate that ascarid eggs immersed in heavy mineral oil at room temperatures (22° to 25° C.) for 125 days do not undergo division and can not become infective under such condition. Eggs immersed for 2 hours in 10 per cent and 20 per cent commercial lye solutions, however, developed to the infective stage when subsequently incubated, indicating that even very strong lye solution brought into intimate contact with eggs for 2 hours does not destroy them or inhibit development.

Experiments were made to obtain additional information as to the identity of the ascarid of man with that of swine. The results point to the conclusion that the human ascarid may develop in pigs, although additional work is desirable to support this belief.

### TREATMENT AND CONTROL OF EXTERNAL PARASITES.

Tests of substances intended to prevent infestation with ox warbles were continued, the substances tested including processed crude petroleum or fuel oil, pine-tar emulsions, and coal-tar creosote placed in wading tanks. The fuel oils and pine tar did not prevent infestation, but a 2 per cent solution of coal-tar creosote prevented infestation of 12 treated animals in all cases where part of a herd was treated and the remainder left untreated as check animals. Of the 12 check animals 8 became infested.

Animals grossly infested with warbles were treated with sulphur dioxid gas in a gas chamber to determine the efficacy of this form of treatment. The experiments were made in January, when the openings in the skin were full sized and before the warbles had begun to emerge. About 90 per cent of the warbles were killed by exposure

of the animals to the gas for 25 minutes and no bad effects from the treatment were noted.

The sulphur dioxid gas treatment was also tested on chronic cases of horse mange, but without success. The experiments indicate that the gas at the concentration used does not destroy all mites or eggs present.

Further tests of sulphur dioxid gas were made to determine its effect on cattle lice. The results show that 20 minutes' exposure to the gas destroys all lice, but does not destroy the eggs, and that louse eggs will hatch after 30 minutes' exposure to the gas.

Experiments were made to ascertain a satisfactory treatment for grub-in-the-head of sheep, a cause of considerable loss, especially to buck herds. Many of the grubs, especially in the early stages of development, apparently can be destroyed by the application of equal parts of chloretone (trichlorbutyl alcohol) and ether, or liquid petrolatum and chloroform applied as a spray with an ordinary atomizer. Further work is necessary to ascertain whether the treatment is practicable and effective.

### TESTS OF ANTHELMINTICS.

Further studies have been made on the use of carbon tetrachlorid as an anthelmintic. This drug, first proposed as a remedy for hookworm infestations by this laboratory in 1921, has now been extensively used throughout the world for the treatment of human beings infested with hookworms, over 60,000 cases having been treated in Fiji alone, and numerous other cases in the United States, Mexico, Jamaica, Dutch Guiana, Brazil, the Philippines, Borneo, Ceylon, Samoa, China, Japan, Australia, India, England, and elsewhere. In the spring of 1923 it was admitted to the list of new and nonofficial remedies and is now under consideration for admission to the United States Pharmacopœia. Clinical experience and animal experiments have borne out the experimental evidence obtained in this laboratory to the effect that this drug is distinctly more effective in removing hookworms than are chenopodium, thymol, betanaphthol, or any other drugs used to remove hookworms. It is also cheaper than any of these drugs. In the great majority of cases it causes but mild and transient symptoms of discomfort, and patients who have taken this drug and any other hookworm remedy regularly express a preference for carbon tetrachlorid. As a rule, patients can do the usual day's work on the day of treatment, whereas with other drugs patients usually lose a day or several days from work, a matter of great importance in mass treatments and in the hospitalization item for civilians or armed forces.

Clinical experience, however, shows that there are certain persons and animals susceptible to bad effects from the drug, and studies have been carried out with a view to finding some way to make this drug safe for these exceptional cases. Investigators at Johns Hopkins University having shown that Epsom salt administered at the same time as other drugs prevents to a large extent, or even entirely, the absorption of the other drugs, experiments to test the effects of the administration of Epsom salt with carbon tetrachlorid to dogs were undertaken in the Zoological Division. The experiments with huge doses of carbon tetrachlorid (up to 20 cubic centimeters per

kilogram of body weight) were inconclusive, as such doses caused vomiting. However, experiments with therapeutic doses showed that carbon tetrachlorid administered simultaneously with Epsom salt maintained its anthelmintic efficacy against hookworms. Seven thousand persons have been given the simultaneous treatment in Fiji, and apparently this method of treatment prevents even the transient headache formerly noted. This being the case, it appears probable that the simultaneous administration of Epsom salt with carbon tetrachlorid will serve to prevent many, if not all, of the accidents which follow in those cases where patients exhibit a high degree of intolerance for carbon tetrachlorid administered without purgation or followed by purgation.

Critical tests of arecolin hydrobromid as a drug for removing tapeworms from dogs show that this drug will remove all the tapeworms present in the majority of animals treated, but that in some cases it will remove only part of the worms and in other cases will fail to remove any.

Tests of various anthelmintics injected by rectum into poultry showed that the small cecum worm, a difficult worm to remove with anthelmintics administered by the mouth, could be removed by these injections, 90 per cent of the worms coming away after an injection of 0.1 cubic centimeter of oil of chenopodium in 5 cubic centimeters of a bland oil in the case of birds weighing 1.5 pounds each.

Tests of the intravenous injection of carbon tetrachlorid, of tartar emetic, and of novarsenobenzol indicated that these drugs as administered were ineffective in destroying the agamic forms of *Strongylus vulgaris*, the worm which causes verminous aneurisms in horses.

### MISCELLANEOUS INVESTIGATIONS ON ANIMAL PARASITES.

An experiment in parasitic infestation of dogs before birth was carried out by feeding eggs of a dog ascarid, *Belascaris marginata*, to a pregnant bitch. The pups were examined the day they were born and the following day, and larval ascarids were found in the liver and lungs. This work throws additional light on the occurrence of ascarids in pups and shows the necessity for additional precautions in raising dogs free from worms.

Studies of the toxic effect of Ascaris fluid on man were carried out and pronounced ill effects of a pseudo-anaphylactic nature were demonstrated.

Additional work on strongyles of the horse and of related animals has been carried out from a systematic standpoint and with a view to determining something in regard to the life histories. A new species of strongyle from the zebra has been found and described in a paper now in manuscript.

The work on the life history of tapeworms of sheep has been continued and some results have been obtained which promise to throw some light on this subject.

During the year 724 fecal samples from imported sheep dogs were examined for parasites that might be injurious to livestock. Of these, 58 dogs were found to be infested with tapeworms of the genus Tænia and were subjected to anthelmintic treatment before release from quarantine.

Various papers reporting the above-mentioned and other work were published, some in the department series and others in outside journals.

The index catalogue of medical and veterinary zoology has been continued and preparation has been made for publishing in cooperation with the United States Public Health Service additional parts of this highly valuable work.

## DIVISION OF VIRUS-SERUM CONTROL.

The regulatory work under the virus-serum-toxin act of 1913 has been continued by the Division of Virus-Serum Control under the supervision of Dr. D. I. Skidmore, chief. This work consisted of the issuance of licenses to establishments producing veterinary biological products intended for sale in interstate commerce; the inspection of such establishments as to sanitary conditions and methods of production; the supervision of the production and testing of products, and the issuance of permits for the importation of veterinary biological products from abroad. It also involved the consideration and disposal of claims made by firms producing alleged remedies for hog cholera and other swine diseases.

At the close of the year 95 establishments were operating under licenses, as compared with 91 at the end of the preceding year. During the year 3 establishments discontinued operations and 7 new establishments began operations under licenses. Twenty licenses were terminated without prejudice, most of them being reissued later for such products as the firms desired to continue to produce. At the close of the year there were 60 licensed establishments producing only anti-hog-cholera serum and hog-cholera virus, 28 producing other biologics only, and 7 producing both of the foregoing classes of products. Seventy-five distinct classes of biological products other than anti-hog-cholera serum and hog-cholera virus were produced under licenses.

Inspectors of the division inspected and admitted 442,878 hogs and 1,504 calves to the premises of licensed establishments for use in the production and testing of serum and virus, while 70 hogs were rejected on inspection. In subsequent inspections 25,989 hogs were rejected on account of conditions which made them unsuitable for the production or testing of licensed products.

During the year 856,358,652 cubic centimeters of anti-hog-cholera serum were produced by licensed establishments. Of this quantity, 143,996,700 cubic centimeters consisted of clarified serum. The quantity of hyperimmune blood and serum in an incomplete form destroyed under supervision amounted to 3,896,425 cubic centimeters, while the quantity of serum in a completed form destroyed amounted to 6,737,459 cubic centimeters. The quantity of simultaneous virus produced was 36,221,820 cubic centimeters, while 535,090 cubic centimeters in incompleted form and 892,758 cubic centimeters after being completed for marketing were destroyed. The quantity of hyperimmunizing virus produced was 182,827,682 cubic centimeters, of which 8,053,150 cubic centimeters was destroyed at the time of collection and 373,675 cubic centimeters after preparation. In addition 713,708 cubic centimeters of inoculating virus was produced.

During the year 11,353 tests were made to determine the potency and purity of anti-hog-cholera serum and 2,109 tests of hog-cholera virus were made to determine its purity. From November 1, 1922, to the close of the year 1,287 tests of hog-cholera virus for virulence were made.

During the year 64 subcultures, including 149 strains of organisms for use in the production of biological products under license were collected for laboratory examination. Of these strains, 124 were found to be satisfactory and 15 unsatisfactory or contaminated. Ninety-one samples of products were also collected for laboratory examination; 68 were found satisfactory and 23 unsatisfactory.

The division continued its cooperation with the Bureau of Chemistry in preventing the sale of worthless remedies for hog cholera and other swine diseases. Probably the most important case receiving attention was that of the successful prosecution of a company for marketing an alleged remedy for hog cholera and other diseases of swine for which most extravagant claims were made. The preparation was found to consist of a few common drugs, including a large amount of arsenic, none of which possess curative value for the diseases in question.

## EXPERIMENT STATION.

The character of the work at the experiment station at Bethesda, Md., under Dr. E. C. Schroeder, superintendent, was similar to that of previous years and comprised independent investigations of infectious diseases of the lower animals, investigations in cooperation with other scientific divisions of the bureau, and the provision of facilities for the other divisions to make investigations under normal or natural farm and field conditions.

### BOVINE INFECTIOUS ABORTION.

Infectious abortion of cattle remained throughout the year the major subject of study. It is too early to say what the results will be of the control measures against the disease which have been formulated and are now being tested in several large, privately owned herds of purebred cattle. It is apparent, however, that there are difficulties in the way of properly carrying out on the farm measures of control which seem simple enough at an experiment station.

Attention has been given to other possible carriers of the parasite of infectious abortion than cattle and swine, and this work will be continued.

Further investigations have been made on the quality and purity of commercial abortion vaccines and bacterins, and investigations are in progress to determine whether some modification in the preparation of abortion vaccines may make them more uniformly potent and whether some modification in the preparation of abortion bacterins may lead to the production of a bacterin that has some virtue.

The investigations mentioned in last year's report, regarding the recrudescence of abortion phenomena in infected herds that had apparently become immune, when such herds are exposed to other strains of the Bang abortion bacillus than those from which their seeming immunity had arisen, are still in progress. Such work is slow, and while it seems probable that cattle which have ceased to

abort as a result of exposure to cattle strains of the abortion bacillus may again abort as the result of exposure to strains virulent for swine, a definite conclusion that this is the case must await stronger evidence than has been so far obtained.

Additional work on the differences between strains of abortion bacilli isolated, respectively, from cattle and swine has been continued and has given results confirmatory of those previously reported.

### TUBERCULOSIS.

Investigations on tuberculosis have dealt with the mode of infection, the various ways in which animals may be sensitized for tuberculin, what may be done to modify and improve the available tests for the purity and potency of tuberculin, and the occurrence of virulent tubercle bacilli in butter and cheese.

A study of the sensitization of animals for tuberculin was undertaken because of its bearing on the occurrence of tuberculin reactions in cattle in which no lesions of tuberculosis are found on post-mortem examination. While the great majority of such cases are undoubtedly incipient and undeveloped cases of tuberculosis, a small proportion requires some other explanation. As animals can be sensitized to tuberculin through injections into their bodies of either dead tubercle bacilli or tubercle bacilli which are not truly pathogenic for them, it seems probable that the swallowing of tubercle bacilli of the human type scattered by tuberculous attendants may account for some cases.

Tests of purity and potency of commercial tuberculins generally have given satisfactory results. In a few instances in which either the purity or the potency of a product was found to be lower than the required standard measures were taken for its withdrawal from the market.

Tests of cheese revealed the presence of virulent tubercle bacilli in the product of only one manufacturer, who, when he was informed, adopted corrective measures which further tests proved to be effective.

Tests of butter for tubercle bacilli revealed a very heavily contaminated condition of two samples. Correspondence with the manufacturer led to the correction of the evil.

### MISCELLANEOUS WORK.

A number of tests were made on the value of alleged cures for infectious diseases of animals, and a number of minor investigations regarding animal diseases and their causes were conducted. Tissues were examined to determine whether the animals from which they were obtained had succumbed to infectious diseases requiring special attention, and a number of cases of rabies in animals were diagnosed. Rabies was unusually prevalent in the region in which the experiment station is situated.

A large number of small experiment animals were raised at a cost hardly greater than half the current market prices. Biological products of different kinds were supplied to other laboratories of the bureau. Every available portion of the station's land was kept under intense cultivation to raise forage for experiment animals.

# REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
*Washington, D. C., September 24, 1923.*

SIR: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1923.

Respectfully,

WM. A. TAYLOR,
*Chief of Bureau.*

HON. HENRY C. WALLACE,
*Secretary of Agriculture.*

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## WORK AND ORGANIZATION OF THE BUREAU.

The Bureau of Plant Industry conducts the work of the department dealing directly with the production problems of all plants except forest trees. It covers such features as the investigation of all plant diseases, including those affecting forest and ornamental trees; the breeding of improved varieties of ornamental and crop plants; the introduction of promising seeds and plants from foreign countries; the improvement of cultural methods; and the development of methods for the utilization of perishable crops, such as fruits and vegetables.

In cooperation with the authorized State activities it conducts service campaigns for the control of black stem rust of wheat through eradication of the common barberry in 13 important wheat-growing States; the control of the destructive blister rust of the white pine in the New England, Great Lakes, and Pacific Northwest regions; and the eradication of the highly infectious and destructive citrus canker from the subtropical portions of the country.

For the purpose of economic administration the work is divided into 125 group projects, comprising in all 325 subsidiary projects.

The appropriations available for the work of the bureau for the past fiscal year were approximately $3,770,000. This was apportioned as authorized by law to the several types of work under way as follows:

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|---|---|
| Research work | $2,500,000 |
| Service work | 860,000 |
| Extension work | 40,000 |
| Regulatory work | 10,000 |
| Congressional seed distribution | 360,000 |
| Total | 3,770,000 |

The work of the bureau is carried on by the following organization:

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|---|---|
| Office of the chief | William A. Taylor, physiologist and pathologist and chief of bureau. |
| | K. F. Kellerman, physiologist and associate chief of bureau. |
| | H. E. Allanson, assistant to the chief of bureau. |
| Laboratory of plant pathology | Erwin F. Smith, pathologist in charge. |
| Plant-disease survey and pathological collections. | C. L. Shear, pathologist in charge. |
| Fruit-disease investigations | M. B. Waite, pathologist in charge. |
| Citrus-canker eradication | Directed by the associate chief of bureau. |
| Forest-pathology investigations | Haven Metcalf, pathologist in charge. |
| Blister-rust control | S. B. Detwiler, pathologist in charge. |
| Cotton, truck, and forage crop disease investigations. | W. A. Orton, pathologist in charge. |
| Crop physiology and breeding investigations. | W. T. Swingle, physiologist in charge. |
| Soil-bacteriology investigations | F. Löhnis, bacteriologist in charge. |
| Soil-fertility investigations | Oswald Schreiner, biochemist in charge. |
| Crop acclimatization and adaptation investigations. | O. F. Cook, bionomist in charge. |
| Fiber-plant investigations | L. H. Dewey, botanist in charge. |
| Drug, poisonous, and oil plant investigations. | W. W. Stockberger, physiologist in charge. |
| Plant physiological and fermentation investigations. | H. L. Shantz, physiologist in charge. |
| Agricultural technology | N. A. Cobb, technologist in charge. |
| Seed-testing laboratories; enforcement of seed-importation act. | E. Brown, botanist in charge. |
| Cereal investigations | C. R. Ball, cerealist in charge. |
| Tobacco and plant-nutrition investigations. | W. W. Garner, physiologist in charge. |
| Alkali and drought resistant plant investigations. | T. H. Kearney, physiologist in charge. |
| Sugar-plant investigations | Directed by the associate chief of bureau. |
| Economic and systematic botany | Frederick V. Coville, botanist in charge. |
| Dry-land agriculture | E. C. Chilcott, agriculturist in charge. |
| Western irrigation agriculture | C. S. Scofield, agriculturist in charge. |
| Horticultural and pomological investigations. | L. C. Corbett, horticulturist in charge. |
| Gardens and grounds | E. M. Byrnes, assistant in charge. |
| Demonstrations on reclamation projects. | A. C. Cooley, agriculturist in charge. |
| Arlington Experiment Farm | E. C. Butterfield, assistant horticulturist in charge. |
| Foreign seed and plant introduction | David Fairchild, agricultural explorer in charge. |
| Forage-crop investigations | C. V. Piper, agrostologist in charge. |
| Congressional seed distribution | R. A. Oakley, agronomist in charge. |
| Biophysical investigations | G. N. Collins, botanist in charge. |

### NUMBER OF EMPLOYEES.

On August 31, 1923, the numerical strength of the bureau was as follows: In Washington, 706; outside of Washington, 1,637; making a total of 2,343. Of this number 1,645 were permanent employees and 698 temporary workers. Of the total number of employees 1.457 were technical workers.

From September 1, 1922, to August 31, 1923, changes in the personnel of the bureau were as follows: Appointments, 1,184, of which 308 were permanent and 876 temporary; retirement, 1; resignations and terminations, 943, of which 229 were permanent employees and 714 temporary workers. There were 22 transfers, and 40 furloughs were granted. Five employees died during the year.

### PUBLICATIONS.

The new publications of the bureau (Department Bulletins, Farmers' Bulletins, Department Circulars, and miscellaneous documents, with contributions to the Yearbook and to the Journal of Agricultural Research) numbered 119, of which 16 were joint contributions with educational institutions, State agricultural experiment stations, or with other bureaus or offices of the department. These 119 publications contain 3,802 pages, 404 full-page plates, and 853 text figures, and were issued in first editions aggregating 1,169,585 copies.

The contributions of this bureau to the series of Farmers' Bulletins numbered 17; Department Bulletins, 35; Department Circulars, 16; and to the Journal of Agricultural Research, 36. These publications show in considerable detail some of the activities of the bureau.

The following statement outlines the work of the bureau not otherwise recorded, summarizing the status of the most significant accomplishments during the past fiscal year.

## FIELD CROPS.

### WHEAT.

*Bunt.*—Strains of wheat immune or highly resistant to bunt, or stinking smut, have been obtained from hybrids and selections of commercial varieties in cooperation with the State stations in Oregon, Washington, and California. These now are being tested for yield, milling and baking quality, and other factors. In addition to Ridit, which is being commercialized, two immune strains, Hussar and Martin, and several other very resistant strains, including White Odessa, Sherman, and several selections of Turkey, are being extensively tested.

*Flag smut.*—Numerous varieties and strains of wheat were grown in connection with flag-smut studies in cooperation with the Illinois station. In addition, about 200 head rows were grown to determine resistance to the disease. Notes recorded by the pathologists show several of the lots tested to be highly resistant to or immune from the disease. Several hundred heads were selected for continuing the experiment. The Shepherd variety is being increased, and several other strains are being increased on a smaller scale but as rapidly as possible. The results show the possibility of controlling flag smut by the use of resistant varieties. What was looked upon at the time of its discovery a few years ago as a very serious and threatening disease has been deprived thereby of much of its menace. Serious losses from it can be avoided in the future by growing strains known to be immune.

During 1923 flag smut of wheat was found in one new State, Kansas, and in nine additional counties in the States of Illinois and Missouri. In Illinois the State department of agriculture found the disease in the counties of Macoupin, Greene, Scott, Logan, and Hancock. In Missouri this bureau, cooperating with the Missouri State College of Agriculture, discovered flag smut for the first time in St. Charles, Warren, Platte, and Buchanan Counties. In Kansas infestations were found by men from this bureau and the State Agricultural College in four counties in the northeastern part of the State, namely, Wyandotte, Leavenworth, Atchison, and Miami.

*Rosette.*—The rosette of wheat, the cause of which is as yet unknown, recurred in Illinois and Indiana, both in experimental plats and commercial fields. Extensive sowings of wheat strains on soil infected with rosette, in cooperation with the Illinois, Indiana, and Wisconsin stations, have shown that many of them are immune. Selection of disease-free plants in a badly infested field resulted in immunity from the disease in the progeny of these plants. This mass-selected lot is similar in appearance to the very susceptible variety from which the selections were made. Attempts to establish strains of this and other varieties resistant to both flag smut and rosette are under way.

*Scab.*—By studying both healthy and infected wheat and corn seedlings grown in parallel series at different soil temperatures, it has been found that at comparatively low soil temperatures the wheat seedling develops very sturdily, with thick cell walls, which soon become lignified and suberized and as a result are highly resistant to the attacks of the fungous parasite. At higher temperatures it was found that wheat seedlings developed with much less vigor, with cell walls much thinner and largely pectic in nature. As a result they are readily penetrated by the parasite. The reverse was found to be true in the case of corn seedlings; that is, weak, susceptible plants developed at the lower temperatures and vigorous resistant plants at the higher soil temperatures. This is in accord with the behavior of these seedling blights under field conditions.

Special studies also were made on the head-blight development of wheat scab. It was found that high humidity during the blooming stage of the wheat head is most favorable for infection. This was found to correlate perfectly with the greatest losses from wheat scab during 1919 and 1920; that is, in the areas where summer rains came at such times as to produce high relative humidity during the flowering stage, there the greatest losses from wheat scab occurred.

*Take-all.*—The true Australian take-all of wheat, caused by the fungus *Ophiobolus graminis* Sacc., was found in the States of Oregon, Washington, California, Arkansas, Kansas, Tennessee, North Carolina, and New York. During the past year the disease was not reported from Virginia, although it had been found at one point in that State previously. In Tennessee it was found to a limited extent at one point. In North Carolina it was found only sparingly in four counties.

*Barberry eradication to control black stem rust.*—The campaign for the eradication of the common barberry to prevent or materially reduce epidemics of black stem rust is conducted in cooperation with the State agricultural college in each of the 13 States in the eradica-

tion area, with the State department of agriculture in most of them, and with the Conference for the Prevention of Grain Rust, located at Minneapolis, Minn. It was begun in the spring of 1918 and is now in its sixth year.

From the beginning of the campaign to June 30, 1923, almost all cities, towns, and villages in the 13 States were surveyed. The original survey has been completed in Wyoming, and but few counties remain to be covered in Colorado and Montana. The survey in the other 10 States has progressed rapidly, and an area equivalent to 484 counties has been covered. Resurveys are made from time to time of each property on which barberries have been found. Properties in the vicinity of large bushes, either cultivated or escaped, which are old enough to bear seeds have been designated for especially careful resurvey.

During the entire campaign 5,847,979 bushes have been located on 56,747 properties. Of these, 3,437,178 were escaped bushes on 3,340 farms. A total of 5,196,768 bushes have been destroyed on 53,165 properties. Chemicals are to be applied to many of the 651,211 bushes remaining on 3,582 properties. Seedlings to the number of 38,178 have been destroyed on 445 properties.

Common rock salt or dilute sodium arsenite, when carefully applied, has been found effective and economical for destroying common barberry bushes. Eradication by digging is not effective in stony or heavy ground.

OATS.

*Varietal distribution.*—The data obtained in the oat varietal survey which was made in 1919 in cooperation with the then Bureau of Crop Estimates have been tabulated in final form. These data show that 11 varieties of oats each are grown in the United States on 1 per cent or more of the total acreage. In the order of their importance, these varieties are Silvermine, Red Rustproof, Swedish Select, Kherson, Green Russian, White Tartar (White Russian), Albion (Iowa No. 103), Early Champion, Burt, Richland (Iowa No. 105), and Lincoln.

*Extension of improved varieties.*—The four new pure-line varieties, Cornellian, Comewell, Standwell, and Empire, developed in cooperation with the department of plant breeding at the Cornell University Agricultural Experiment Station and distributed to farmers for the first time in the spring of 1921, continued to prove satisfactory under farm conditions and again were much in demand by farmers in the spring of 1923. In tests conducted in seven counties of the State in 1921, these varieties on the average outyielded others, such as Victory, Golden Rain, and Mammoth Cluster, by 2 to 10 bushels per acre. Continued progress was made in breeding a white-kerneled strain in which the undesirable gray color of the Cornellian has been eliminated, though still retaining the unusually high yielding quality of that variety.

Albion (Iowa No. 103), Richland (Iowa No. 105), Iowar, and Iogren, the four improved varieties developed in cooperation with the Iowa Agricultural Experiment Station, are becoming of greater importance each year. The estimated area devoted to the Albion and Richland varieties, as determined by the varietal survey already mentioned, was as follows: In Iowa—Albion, 1,088,000 acres; Rich-

land, 373,000 acres; in Illinois—Albion, 338,000 acres; Richland, 21,000 acres. Relatively smaller acreages are grown in adjoining States. These acreages, particularly that of the Albion, have been doubled or perhaps trebled since 1919. The two newer improved varieties, Iowar and Iogren, continue most promising, the Iowar outyielding the Albion by a few bushels per acre. The Iogren, a selection from the Green Russian oat first distributed to farmers of northern Iowa in 1921 and further distributed in that section in 1922, showed marked superiority in yield over the common unselected stocks of the parent variety.

### CORN.

Investigations have shown various parasitic and semiparasitic bacteria and fungi important in causing root, stalk, and ear rots. In addition to the bacterial wilt, or Stewart's disease, caused by *Aplanobacter stewartii* (Smith) McCulloch, and bacterial root and stalk rot caused by *Bacterium dissolvens* Rosen, what appears to be a new bacterial disease is being investigated. The principal fungi which have been found to be aggressive parasites are *Diplodia zeae* (Schw.) Lev., *Cephalosporium acremonium* Corda, and *Gibberella saubinetii* (Mont.) Sacc. *Fusarium moniliforme* Sheldon often is found associated also, but this fungus does not seem to be aggressively parasitic on healthy corn. Other fungi also are being studied, but as yet their relations to disease causation have not been determined. It has been found that Diplodia and Cephalosporium seem to be the most important of the fungous parasites of corn in this complex. These fungi may attack corn plants separately and each cause important reductions in yield, or in some cases they are found associated on the same plants, when the losses are aggravated. In the case of the disease caused by Diplodia, it has been found that comparatively high soil temperature together with high soil moisture during the seedling stage of the corn plant favors infection and results in the greatest reduction in yield. In experimental plats Diplodia was found to cause as much as a 34 per cent reduction in yield. As a result of laboratory studies on *Fusarium moniliforme*, the ascigerous stage of this fungus has been developed in artificial culture.

In addition to the development of resistant varieties, the indications are that the control of the entire group of root and stalk rots will require special soil management. Where the nonparasitic types occur by themselves, apparently the proper fertilization and amendments are sufficient. Where the parasitic types are concerned, especially the fungous parasites, careful consideration apparently must be given to crop rotations as well as to fertilizers and amendments.

### FORAGE CROPS.

*New grasses for the Southeast.*—The value of molasses grass for Florida and the immediate Gulf coast is now well demonstrated, and efforts are being made to induce seedsmen to carry supplies of seed, which have to be imported from Brazil. Dallis grass (*Paspalum dilatatum*) and Bahia grass (*Paspalum notatum*) are proving to possess great value for the Southeast, but difficulty is experienced in obtaining satisfactory seed supplies. The seed of the former is im-

ported from Australia, and that of the latter, which can be obtained in abundance from Cuba and Costa Rica, has proved to be of exceedingly low germination. It is hoped that methods may be found for obtaining better germination from the imported seed of Bahia grass. Another species of Paspalum (*P. larranagai*), which has been found to be a valuable grass in Louisiana and Mississippi, promises well for Florida and other parts of the Southeast, and the indications are that satisfactory domestic seed supplies of this grass may be developed.

*Sudan grass.*—The use of Sudan grass for summer pasture is being encouraged, and the acreage of it devoted to pasture has increased phenomenally, especially east of the ninety-eighth meridian in the States of Kansas and Nebraska. It has increased greatly in Iowa, Missouri, and Indiana.

*Soy beans.*—The soy bean is rapidly approaching the point where it may be regarded as a staple crop. Its popularity is rapidly increasing in the Corn Belt, and it promises to become a valuable oil plant as well as forage crop. Several factories equipped with machinery for the manufacture of soy-bean oil and meal as well as of various food products, such as soy sauce, flour, milk powder, and special soy-bean food products, were in operation, using domestic-grown beans. Investigations with soy beans have been extended considerably to meet the increasing demands for information relative to the culture, varieties, and utilization of the crop. Many of the introductions of soy beans received from Manchuria, Japan, and China in 1922 appear to be of promise for central and northern conditions. Much progress is being made with soy beans in the South, where in past years the crop has not been very popular because of the shattering tendencies of the varieties that were grown. The Biloxi variety, however, on account of its nonshattering characteristics, and the Laredo, which has been found to be resistant to nematodes and wilt, have done much to increase the popularity and acreage of the crop in the Gulf Coast States.

*Cowpeas.*—The principal lines of investigation with cowpeas were testing introductions, crosses, and selections, and cooperative variety tests. Several varieties obtained by Dr. H. L. Shantz from Africa and new selections from hybrids appear to be of some promise. Because of their late-maturing tendencies the African sorts are more suitable for the Southern States than for farther north. The Victor variety, developed by the department, has given the best results in tests, especially on lands infested by wilt and nematodes, and a wide distribution of it has been made.

*Velvet beans.*—Efforts are being continued to popularize velvet beans as a valuable forage and soil-improving crop in the South by developing new varieties. Through the crossing of early-maturing strains with the bush variety, some promising hybrids have been developed, and two early strains, the Early Arlington and Tracy's Early Black, have been obtained. Some of these early-maturing strains are very prolific and will apparently make it possible to push the velvet-bean belt appreciably northward from its present limits.

*Mung beans.*—The mung bean is coming into prominence through its freedom from attack by the Mexican bean beetle. It is now being extensively advertised throughout the South for forage purposes.

Tests have been conducted in various Southern States for the purpose of studying its resistance to the attack of the Mexican bean beetle and to obtain definite information of its yield of forage and seed as compared with other crops.

*Vetches.*—The testing of a large number of vetches at many points in the South has indicated the conditions to which the various species are best adapted. The woolly podded vetch continues to show its superior value for the Southern States because of its vigorous winter growth and its comparative resistance to the disease caused by *Protocoronospora nigricans.* Investigations have continued with purple vetch, and the seed-growing area of this species has been extended in California and Oregon. This vetch is especially well adapted for use as a green-manure crop in citrus orchards in California. It now appears that a source of seed has been permanently established. Excellent results are still being obtained from Hungarian vetch (*Vicia pannonica*). It is thought that this crop will be of much value, especially on wet clayey soils in the Pacific Northwest.

*Sweet clover.*—The utilization of sweet clover has been studied in the field and in cooperation with the North Dakota Agricultural Experiment Station. This crop is making a place for itself as one of the most reliable summer-pasture plants. Selection work is going on at our station at Redfield, S. Dak., where a new species of yellow-flowered sweet clover that gives promise of usefulness is being grown.

*Red clover.*—The chief line of study of red clover has again been that of the various strains from foreign countries. The following State experiment stations are now cooperating in this work: New Jersey, Maryland, Virginia, Tennessee, Kentucky, Missouri, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Iowa, Idaho, and Oregon. Seed has also been furnished the extension service in New Hampshire and New York.

Results so far as Italian seed is concerned in the main have been like those of previous years, showing that crops winterkill easily or suffer after the first cutting, and in the future more emphasis will be placed on the work with French and Chilean seed.

*The stem nematode.*—The nematode that infests certain bulbs as well as the stems of clover, alfalfa, and strawberries has increased in importance as a parasite in the Northwestern States. In the large irrigated clover-seed producing sections of southern Idaho it has seriously affected yields; it has been found severely attacking alfalfa at several places in Oregon and Washington and is known to be present at one point in California and one in Colorado. The indications are that this pest would be a menace to alfalfa if it should become generally prevalent in the irrigated regions where alfalfa is grown as a main crop, as observations and experiments have shown that it is spread rather rapidly in the field by drainage water and other agencies and may be distributed widely in the hay cut from diseased fields. The disease does not usually become serious the first year, but develops to such an extent by the third year that infested fields are rendered unproductive and have to be plowed up.

Several annual crops are known to be susceptible to this nematode, and wild hosts have also been found in both the western and eastern sections of the country. Studies of biological strains have indicated that it is possible for one strain of the nematode to adapt itself

gradually to other susceptible hosts. Extensive rotation experiments that are under way in the affected clover and alfalfa sections give promise of an effective means of control.

This nematode has also been causing losses in a number of large commercial bulb gardens in the Northwest. Imported bulbs have been found to be affected, and the possibility of the pest being widely distributed on both imported bulbs and those distributed from infested gardens in this country is being given serious consideration.

*Poisonous plants in pastures and ranges.*—Following the preliminary botanical survey in June, 1922, of the areas in Texas where the "loin disease" of cattle is prevalent, a second survey was made in the following September. The principal areas where cattle have died from this disease are in Harris and Brazoria Counties, although some losses have occurred in Waller, Fort Bend, Montgomery, and Galveston Counties. This is a region of flat wet prairies and shallow ponds, ranging in altitude from 40 to 100 feet above sea level. It is a difficult area to drain, and only a small portion is under cultivation. Observed superficially it appears to be a fine grazing region, but a critical examination of the flora leads to the opposite opinion. The true grasses and browse of desirable kinds are very scarce. Rushes (*Juncus* spp.) and swale grasses (Cyperaceæ) in the spring while tender are much eaten. Many other herbaceous plants are represented, among which are *Lippia cuneifolia*, *Daubentonia longifolia*, and species of Asclepias, Verbena, Petalostemon, Helenium, Rudbeckia, and Baptisia. From what is known of these plants none of them can at present be considered a cause of loin disease.

The poisonous-plant surveys on the ranges of Arizona and New Mexico were continued, as a result of which our knowledge of the identity and distribution of harmful species in this region has been materially extended. Particular attention was given to the occurrence of species of Astragalus, Asclepias, Helenium, Hymenoxys, Lupinus, and Nolina, especially in the Apache, Coconino, Coronado, Prescott, and Tonto National Forests in Arizona and in the Jornado grazing reserve in New Mexico.

As in previous years, specimens of all plants collected in connection with the poisonous-plant surveys have been deposited in the National Herbarium. Since 1910 an average of more than 1,000 specimens has been annually deposited, and in the current year the number was 2,400. In addition, many duplicate specimens have been placed in the Gray Herbarium at Cambridge and in the herbaria of the New York Botanical Garden, the Missouri Botanical Garden in St. Louis, and the Field Museum in Chicago.

*Distribution of new and rare field seeds.*—A distribution was made throughout the entire United States, having for its object the dissemination of seed of new and rare field crops, seed of improved strains of staple crops, and high-grade seed of crops new to sections where the data of the department indicate such crops to be of considerable promise. Each package contained a sufficient quantity of seed for a satisfactory field trial, and the recipient was urged to use it, if feasible, for the production of stocks for future plantings. A report card and a circular giving full directions for the culture of the crop accompanied each package of seed.

During the fiscal year 1923 there were distributed 104,100 packages of forage-crop seeds and 94,200 packages of new and improved varieties of cotton. Among the forage-crop seeds were included Grimm alfalfa, Peruvian alfalfa, Dakota-grown and Kansas-grown alfalfa; Great Northern field beans; Biloxi, Black Eyebrow, Hahto, Laredo, Manchu, Mandarin, Peking, Virginia, and Wilson-Five soy beans; Bush, Early Arlington, and Tracy Early Black velvet beans; Victor, Brabham, and Early Buff cowpeas; carpet grass, Merker grass, and Sudan grass; Siberian and Kursk millets; Bangalia, Chang, and Pedigree Green field peas; Dwarf feterita, Spur feterita, Blackhull kafir, Dwarf Yellow milo, and Sumac sorghum.

The distribution of improved varieties of soy beans was, as last year, the outstanding feature of this distribution. The soy-bean crop has increased greatly, and the new varieties which the department has introduced, when available commercially, will go far toward replacing the varieties now in use in many important sections of the country. Preliminary results from efforts to obtain better forage crops for the South indicate that the new lespedezas, seed of which is being grown for distribution, will prove exceedingly valuable. These will be included in subsequent distributions. The preliminary work, however, has advanced sufficiently to justify a widespread dissemination in the sections where they are adapted. Preliminary tests of the seed of Ladak alfalfa have proved sufficiently convincing to warrant the inclusion of seed of this variety in the distribution the coming year. It is especially adapted to conditions in the northern Great Plains region and in the Northwest.

### TOBACCO.

Field tests conducted on "tobacco-sick" soils in the Connecticut Valley have brought out marked differences in the effects of various crops on the growth of tobacco following in the rotation. The effects of timothy sod, red clover, and corn have been particularly unfavorable, while the growth of tobacco has been much better after onions, after tobacco itself, and on land kept free from vegetation during the previous season.

Field tests in the southern manufacturing and export-tobacco districts have demonstrated that mixed fertilizers containing 2 to 3 per cent of potash applied at the usual rate of 800 to 1,000 pounds per acre frequently do not supply sufficient potash for the tobacco crop. As a result characteristic symptoms of potash hunger frequently develop. When the application of potash is increased to 40 pounds or more per acre these symptoms do not occur, there is a notable increase in resistance to leaf-spot diseases, and the leaf is otherwise improved in quality and in yield. On light soils, and especially in comparatively wet years, "sand drown," a serious deterioration of the tobacco crop, may be expected when a sufficient quantity of magnesia is not contained in the fertilizer or otherwise added to the soil. The quantity of magnesia required by the crop, however, is comparatively small, perhaps not more than half that of the potash which is needed. Both potash deficiency and magnesia deficiency present characteristic symptoms which are easily recognized, and both are readily corrected by suitable applications of fertilizer. With constantly decreasing supplies of cottonseed meal and

other similar materials containing appreciable quantities of magnesia, it is apparent that there will be greater necessity for making special provision for magnesia in the fertilizer mixture.

### COTTON.

*Cultural control of the boll weevil.*—The general value of varieties and agronomic methods for obtaining an early short-season crop of cotton in the presence of the boll weevil is now widely recognized, but there are special problems to solve in determining the full advantage that can be gained by cultural methods of control. One of the problems is to determine more definitely the time when cotton may be planted with the best prospect of fruiting rapidly and of being least exposed to weevil injury. Very early and very late planting have both been advocated as measures for avoiding weevil injury, with various arguments in support of the different views, but satisfactory experimental evidence has not been secured.

The difficulty encountered in the past in such experiments is that later plantings when compared side by side with early plantings usually suffer most, because more weevils are bred on the early plantings, but this difficulty may now be avoided by using poison on the early cotton. The productiveness of the later plantings will determine the practical advantage to be gained by planting all the cotton of a community rather late, to avoid the breeding of more weevils in early-planted fields. If found to be equally effective in avoiding weevil injury, simultaneous later planting, of course, would be much cheaper than the protection of early plantings by poison, though poison might be used effectively later in the season if the crop required protection. To the extent that later planting is shown to be practicable the system of control may be rendered more effective in allowing more of the weevils to emerge and starve for lack of food before the plants are large enough to produce flower buds, which are the food as well as the breeding places of the weevils. A series of such tests of late-planting possibilities has been arranged in cooperation with the Florida Agricultural Experiment Station, with similar experiments at field stations of the department in South Carolina and Texas.

*Development of fruiting parts.*—Careful determination of the rates of growth and periods required for the development of branches, buds, flowers, and bolls has been made with different varieties and in different cotton-growing regions, and a collection of such data is being published. This information is of use in determining the feasibility of various methods that have been suggested for avoiding or reducing weevil injury and also in relation to varieties and cultural questions. A new explanation of the advantage of varieties with upright habits of growth over varieties with wider and more spreading habits and longer fruiting branches is afforded. The relation of the upward growth of the plants to the production of an early crop is shown by the fact that the average interval between the first flowers of successive branches is about three days, while the average interval between successive flowers of the same branch is about six days. This also shows why it is possible to produce more flowers and more bolls in short periods by using close-spaced single-stalk plants and why long-season conditions are required to secure good crops from large spreading plants.

*Utilization of the Acala variety.*—A superior type of upland cotton, Acala, was discovered in southern Mexico in 1906, planted on a field basis in Texas in 1911, and recommended for commercial cultivation in 1916. From being a local favorite in Oklahoma and northern Texas, Acala cotton has now attained such general popularity in the United States that the problem of seed supplies has become acute. On account of the demand and the wide scattering of the seed stocks the danger of mixing with other varieties is increased. This inevitably takes place under the usual conditions of growing and ginning different varieties together. Experience has shown that the reputation of superior varieties is likely to decline as soon as the seed is mixed and ordinary commercial seed stocks are planted. Thus the rapidly increasing popularity of the variety may lead to an equally rapid deterioration of the stock if adequate supplies of good seed are not developed and maintained in communities that will grow this variety exclusively. The development of such communities is being encouraged and assisted by cooperation as far as possible. In view of the promising results in the Southeastern States, this variety seems likely to be grown over the full extent of the Cotton Belt, from North Carolina to the San Joaquin Valley of California.

*A narrow-leaved strain of Acala cotton.*—A narrow-leaved variation of Acala cotton was discovered at San Antonio, Tex., by Rowland M. Meade, who died in 1916. Selections at San Antonio and Greenville, Tex., resulted in the production of a uniform narrow-leaved stock as productive as the parent and with lint of equal or superior quality. To increase the supply of seed as rapidly and as safely as possible, the principal plantings were made in California in 1922 and 1923. A small acreage in North Carolina in 1923 will be followed by other experiments to determine adaptability. There is reason to believe that plants of this type, with very open foliage, may have advantages under weevil conditions, since the shade of such plants is less continuous and the weevil larvæ in the fallen squares are more exposed to heat and drying by direct sunlight Also, the very distinctive type of foliage makes it very easy to detect mixing or crossing with ordinary broad-leaved varieties.

*Classing cotton in the field.*—A preliminary test in the Salt River Valley in the season of 1922 showed that a system of judging the quality of a known variety of cotton by field inspection not only would be practicable but that more accurate and reliable discrimination is possible in this way than by the commercial method of classing small samples from the bales. Though knowledge and skill are required for prompt and accurate judgment regarding the behavior and condition of the plants, the plants in the field are much more accessible to observation than cotton in bales. Among the advantages of field classing are the earlier information obtainable regarding the condition and quality of the prospective crop, the more definite recognition of mixed seed or irregular conditions in the field, and the greater assurance of furnishing the manufacturers with a staple of uniform quality, which is distinctly more valuable.

*Egyptian cotton breeding.*—Maintenance of the purity of the seed of Pima cotton, of which a large supply is required for general planting, has become a difficult problem since upland cotton has begun to be grown extensively in the Salt River Valley. Assistance has been rendered, as heretofore, to the cooperative associations

in Arizona in dealing with this problem. Breeding work with the Pima variety has been continued, the principal objective being to produce a strain yielding more than the present commercial stock. Encouraging progress has been made in this direction, as well as in the development of a smoother seeded strain better adapted to ginning on the roller gin.

Investigation of the phenomena of pollination in cotton since the publication of Department Bulletin 1134, entitled "Self-Fertilization and Cross-Fertilization in Pima Cotton," has established the fact that pronounced selective fertilization occurs in the upland as well as in the Egyptian type; in other words, when pollen of both types is present in equal quantity on the stigmas of the same flower, most of the ovules are fertilized by the like pollen rather than by the foreign pollen. This fact helps to explain the comparatively low percentages of hybrids produced when Egyptian and upland cottons are grown in close proximity and exposed to natural cross-pollination.

Hybrids between two strains of Pima cotton, one of which shows a normal development of the conspicuous red spot at the base of the petal and the other complete absence of the spot or its presence as a mere trace, have been studied intensively, and convincing evidence has been obtained that the "spotless" condition is a simple Mendelian recessive. While the results are chiefly of scientific interest, they indicate that such a character as "spotless" flowers could be transferred readily to a commercially desirable strain and might be useful as a "hall mark" in roguing to keep the seed pure.

Investigations are in progress to determine the degree of isolation which should be given a seed-increase field in order to afford reasonable assurance that accidental cross-pollination will not occur under Salt River Valley conditions.

### BINDER-TWINE FIBERS.

With the present shortage in the production of Yucatan henequen and the prospect that this shortage will continue for a number of years, the problem of providing for an adequate future supply of binder-twine fiber has been given especial attention. The only permanently satisfactory solution of our binder-twine fiber problem is to increase the production of this fiber in the insular possessions of the United States. While Porto Rico and the Virgin Islands offer possibilities for a limited production of henequen and sisal, the principal source of supply of binder-twine fiber other than that obtained from foreign countries will be the Philippine Islands.

A few years ago cooperative work was begun with the Philippine Bureau of Agriculture to encourage the increased production of sisal and maguey fiber in the Philippine Islands. In view of the rapidly increasing consumption of abaca (manila hemp) for binder-twine purposes, this cooperative work has been expanded to include necessary work with abaca. It is entirely possible, if not probable, that the ultimate solution of our binder-twine fiber problem will be an increasing substitution of abaca for henequen in the manufacture of binder twine.

During the past year large quantities of abaca have been used for the manufacture of binder twine, and it has been demonstrated

that under existing conditions abaca can successfully compete with Yucatan henequen as a binder-twine fiber. If this use of abaca can be maintained and increased, the result will be equivalent to an increased production of sisal or henequen within United States territory.

If the Philippine Islands are to produce the binder-twine grades of abaca as cheaply as henequen can be produced under normal industrial conditions in Yucatan it is essential that improvements be made in the abaca industry. Improved varieties of abaca must be developed and distributed, improvement must be made in the methods of cultivating and cleaning it, and steps must be taken to control and eradicate the diseases which have appeared in several Provinces.

In cooperation with the Philippine Bureau of Agriculture, the Bureau of Science, and the College of Agriculture, preliminary steps have been taken during the present year to organize this work.

The cooperative work with sisal and maguey in the Philippine Islands has resulted in a steadily increasing production of both of these fibers. During the past year, however, there has been a decrease in the production of machine-cleaned fiber. As a potential source of supply of sisal and maguey fiber suitable for binder-twine purposes the Philippines become more important each year.

Continued improvement has been made in the quality of the Philippine machine-cleaned maguey fiber. American manufacturers report that this fiber is now entirely satisfactory for binder-twine purposes.

## FRUITS AND NUTS.

### NURSERY-STOCK INVESTIGATIONS.

The work of the nursery-stock project in the eastern United States has been chiefly confined to apple, pear, cherry, peach, and citrus stocks. Between 30,000 and 40,000 apple seedlings from last spring's germination are growing at the Bell Field Station. These seedlings represent nearly 150 varieties of apples, including commercial sorts, French crab varieties, and Malus species. At present the indications are that a good percentage will be of sufficient size for the two larger grades. Much variation in the size of individuals under seemingly the same conditions is being noted as the season progresses. From these types of seedlings those having the best physical appearance, indications of pest resistance, and other factors that determine their value as stocks are being marked for propagation as individuals from root cuttings. From these seedlings also it is hoped to get indications of what commercial varieties or groups of varieties may furnish the most desirable seeds for planting to produce apple stocks commercially.

A part of these seedlings was transplanted when very young by the aid of transplanting boards similar to the types in use by the Forest Service, but specially adapted to handle very small seedlings. The very good stands obtained and the speed in transplanting made possible by their use leads to the belief that if this class of plants is worth transplanting the use of these boards is desirable.

The propagation of apple, pear, cherry, and plum stocks by root cuttings has been continued at the Bell Field Station and at the Virginia Truck Experiment Station, Diamond Springs, Va. At the Bell

station, where individual tree propagations are under way, it is noted in the case of the apple that the stand percentage from different individuals varies considerably. The direct propagation of apple varieties from scion roots has so far given stand percentages too low to make the method of particular use.

At Altadena and San Dimas, Calif., the work this year has shown that the sour orange, the stock commonly used in California for orange, lemon, and grapefruit, can be propagated by root cuttings. This offers a practical way of propagating a strain of sour orange known as the Spanish strain, which seems to be the most desirable strain studied. The increase of desirable types of citrus stocks from root cuttings has been very successful at the Altadena nursery. While the cuttings under some conditions require some time to start, their subsequent growth is rapid and very good stands have been secured. In all the work in vegetative propagation efforts are being made to devise methods capable of commercial application and to determine the most desirable age and size of material to use.

### CITRUS FRUITS.

*Breeding.*—The breeding of new varieties and stocks, chiefly through hybridization, to secure extra hardiness, disease resistance, and adaptation to special soil and climatic conditions, together with other desirable qualities, has resulted in bringing into use several new hybrids. Six of these have been named and described during the past year, three resulting from crosses of the citrange and kumquat, called citrangequats (trigeneric hybrids), and three from crosses of the lime and kumquat, called limequats. Improved methods for the rapid propagation of these and other citrus plants by the use of fine twig cuttings have been worked out and a preliminary description published.

To safeguard the introduction of citrus plants and relatives needed in breeding work and for field trial in the United States improved technique in quarantine procedure and propagation has been developed which may well be termed "aseptic propagation." Many of the new features of this system, both mechanical and horticultural, may with advantage be applied to commercial greenhouse practice. A circular has been prepared for publication describing the various devices invented and the methods used as a protection against insect infestation and infection by microorganisms.

The work of bud selection for the improvement of citrus varieties has been carried on in Florida and Alabama. In Alabama the work has progressed so far that nearly all the buds for growing Satsuma nursery trees are now taken from performance-record trees. In Florida a progeny grove from selected parent trees is being developed at the branch experiment station in cooperation with the Florida Agricultural Experiment Station, which in future years will serve as a source of bud supply for growers and nurserymen.

*Commercial performance records.*—The California Fruit Growers' Exchange, a cooperative organization of citrus growers, established in May, 1917, a bud department for the purpose of making available to nurserymen and growers the results of the bureau's investigations upon bud selection in correlation with tree-performance

records. Up to June 1, 1923, this department had sold to propagators a total of 2,300,000 buds at an average price of about 5 cents each. These buds have been taken from the most productive and desirable citrus trees in orchards where individual tree-performance records have been made for a period of several years. The trees used as sources of supply were selected on the basis of these records, and budwood was cut only from those trees which have consistently borne high yields of uniformly good fruits. During the past year it has been possible to procure part of this supply of selected budwood from the best trees of superior progenies which were originally propagated from the most productive and desirable parent trees.

*The furrow-manure method of applying fertilizers.*—Additional evidence has been secured during the past year as to the superior efficiency and economy of the furrow-manure method of applying fertilizers, particularly barnyard manure or similar organic materials, in citrus orchards in California. With the use of this method, which was originated and developed in the course of these investigations, the plowsole condition present in many irrigated citrus orchards is broken up and the manures applied in the feeding-root zone with a minimum loss of plant food and a maximum return for the fertilization.

*Stem-end rot.*—It has been determined experimentally that the timely removal of the attached stems, or " buttons," from citrus fruits potentially infected with either type of stem-end rot will prevent their decay, provided this removal can be accomplished without injury to the fruit tissues that would give entrance to blue-mold infection. This can be done effectively and inexpensively by an adaptation of the gassing method for hastening the coloring of the fruit, subjecting the fruit to gases from the exhaust of an internal-combustion engine or from a kerosene stove adjusted to give incomplete combustion. It has also been found that spray applications of Bordeaux-oil emulsion timed for the control of melanose will also greatly reduce losses from the Phomopsis type of stem-end rot, though they will not have much, if any, effect on the Diplodia stem-end rot.

*Grapefruit storage.*—The experimental work on grapefruit storage has been completed, and it is now established on a commercial basis. Two cars of grapefruit were cured and stored during the season. With the first car, which was stored in January and removed from storage in March, there was practically no rot and not enough pitting to injure the sale of the fruit. With the second car, which was stored in April and sold during the summer, the pitting was negligible, and the percentage of rot did not increase in two months of storage. A method of curing was worked out whereby the fruit could be cured in three days by exposing it to the gas from kerosene stoves, removing the buttons at the same time. This treatment not only prevents pitting but also eliminates much of the loss which might occur from stem-end rot. The work on coloring citrus fruits in Florida by employing incomplete combustion of petroleum products, such as kerosene or gasoline, was continued throughout the season of 1922–23. As noted above, the adaptability of these methods for removing buttons from fruit in order to prevent losses from stem-end rot has been determined, but under some conditions it is ad-

vantageous to retain the buttons on the fruit. Methods have accordingly been worked out whereby the fruit may be colored without removing the buttons. The effect of temperature and humidity on the coloring process has been determined and apparatus devised for conveniently modifying these conditions. The experimental work on this problem is about completed.

*Citrus-canker eradication.*—The continuation of the cooperative campaign for the eradication of citrus canker conducted in cooperation with Florida, Alabama, Mississippi, Louisiana, and Texas has progressed satisfactorily. No extensive epidemics of canker occurred in any of the cooperating States. Slight infections were found in Florida, Alabama, and Mississippi. In Texas and Louisiana the infections were less frequent and less serious than in former years.

### DATES.

The largest new factor in the date industry has been the large-scale introduction of the Saidy date from Egypt and the successful propagation of several thousand of these imported offshoots under conditions that insure the rapid building up of a stock of home-grown palms. With this variety perhaps best adapted to the Imperial Valley and the Hayany already proved satisfactory for the Salt River Valley, the area devoted to commercial date culture (now largely limited to the Coachella Valley, owing to the exacting nature of the Deglet Noor variety) will be greatly enlarged in the near future. A bulletin has been issued describing the Saidy variety, covering its history, the conditions suitable to its culture, etc., and physiological studies have been conducted on this and other varieties which throw light on many problems previously perplexing.

Rooting offshoots is no longer a matter of serious difficulty. Improvements in the technique of date maturation have been worked out, and storage experiments are under way. Pollination studies show marked differences in the viability of pollen from different males and indicate the necessity for careful selection. The use of hold-over pollen, quite general on early-blooming varieties, has been shown to be a practice of doubtful value, though further studies will be necessary. These pollination studies are of particular importance in the breeding of new and superior varieties, a field already demonstrated as of decided promise.

### SMYRNA FIGS.

Renewed interest in figs as the basis of a fruit industry in California has been awakened by the popularity of canned figs. The Smyrna fig has been found to lend itself particularly well to canning, and a large part of the present crop will be handled in this way. Insect-bearing caprifigs have been supplied to the growers of Smyrna figs from the Maslin orchard at Loomis, Calif., leased to the Department of Agriculture, and cuttings of especially promising caprifigs and new seedling varieties of hybrid origin (such as the nonsplitting Stanford) have been supplied to cooperators for trial. The planting of caprifig orchards in a number of protected places has been encouraged, and the prospect of a serious shortage of fig insects (Blastophaga) in future years is now rather remote.

### PRECOOLING INVESTIGATIONS WITH BERRIES.

The factors chiefly responsible for the decay and deterioration of raspberries and Logan blackberries in shipments to Chicago and other markets in the Middle West were the subject of investigations at Mountain View, Calif. A comparison of the shipping qualities of berries that were commercially handled and similar fruits picked and handled under more careful methods by bureau workers showed approximately four times as many decayed and unmarketable berries in the commercial packages as were found in the carefully handled lots. The results of careful handling were effectively used for demonstration purposes at meetings of the berry growers.

The value of prompt handling in connection with precooling in preparing the fruit for long-distance shipment was quite apparent from the brighter color and added firmness of the berries that were precooled when compared with similar fruit that was held without precooling under iced-car conditions. Raspberries were found to carry in better condition than Logan blackberries when handled by careful methods. In general, the results of the experimental work showed that by the adoption of more careful methods of field handling in connection with the efficient precooling of the fruit raspberries produced in this section may be placed in sound condition in a wide range of markets in the Middle West and Northwest.

### NUTS.

*Pecan culture.*—For several years there have been persistent requests from pecan growers that the department establish test stations at various points within their territory. As the department had no funds with which to purchase or rent land, tenders of sites in several important pecan-growing regions were made to enable it to establish work within the region. As a result about 50 acres of land have been placed at the service of the department for an unlimited period. The area has been fenced, and the necessary office facilities and implement shelter, together with a water supply, are being provided. The site selected, after an examination of a large number offered, is located at a railway station in Lee County, Ga., known as Philema. This area is being improved by the cultivation of leguminous cover crops, and there is adjacent to it a seedling grove of pecans which has been placed at the disposal of the department for top-working purposes. A series of tests to determine the relative value of budding and grafting for top-working pecans has already been begun. Tests to determine the value of pruning the pecan are also under way. A considerable number of crossbred seedling pecans is lined out in nursery rows, and a quantity of nuts, the result of hand pollination, will be available for planting during the coming season. One project which it is proposed to carry out, in addition to the fertilizer work and the cover-crop work which have been under way for several years, is a determination of the factors in the nutrition of the pecan which affect the setting and holding of the nuts on the trees. To this end a plan for irrigating certain blocks in the experimental area will be worked out. Because the natural habitat of the pecan is along river bottoms, where moisture is abundant, it is believed that an adequate supply of soil

moisture is a limiting factor in the successful development of the crop.

*Soil-fertility studies.*—Some valuable data have been obtained showing the response of pecan trees grown on various soil types to fertilizer treatments and cultural conditions. These investigations comprise the study of soil conditions and fertilizer requirements of pecans and were begun in 1918. The work is conducted on an orchard basis in the pecan belts of Florida, Georgia, and Alabama, and large areas are under experimentation. Experiments are located on the Greenville sandy loam, Orangeburg sandy loam, Norfolk fine sandy loam, Norfolk sandy loam, Norfolk fine sand, and Bladen fine sandy loam. A laboratory investigation of the nuts produced on different soil types and under varying fertilizer and cultural treatments has been made in connection with this work. The protein, fat, and sugar content, as well as the yield, size, and filling quality, of the nut were found to be influenced by fertilizers and soil conditions. Larger and better filled nuts were produced by complete fertilizer mixtures high in nitrogen. Potash increased the oil or fat content and nitrogen the protein content of the kernel. A study of the nature and chemical constituents has been made of pecan oil, which was found to contain oleic, linolic, palmitic, and stearic acids and a small amount of phytosterol. The use of fertilizers and the growing of cover crops for green manuring in connection with pecan growing are increasing, and information concerning these factors is much needed. Some very good information for the guidance of growers has been obtained.

*Nut storage.*—The nut-storage investigations, which have been in progress about three years and include storage experiments on several different varieties of each of the commonly grown cultivated varieties of nuts of the United States, are about completed. In this work it has been shown that English walnuts can be stored for about three years at 32° F. and will be in good condition at the end of that time. The pecans at 32° F. were in fairly good condition at the end of 2½ years, while even the best of the almonds had deteriorated somewhat at the end of that time. Filberts can be stored for two years and perhaps longer at 32° F. At 40° F. the nuts deteriorate more rapidly than at 32° and hardly last more than 12 or 15 months in common warehouse storage. These experiments are about completed and the results will be published soon.

## VEGETABLES.

### POTATOES.

*Improvement of seed stocks.*—In connection with studies of the seed-potato supply investigations are being continued on the productivity of mature and immature seed, the effect of storage temperatures on the productivity of seed, the effect of the source of seed supply as well as that of the size of the seed piece, together with a test of germinated and ungerminated seed stock to determine the best practices for growers to follow. In addition to these the line of investigation of so-called "running out" of varieties is being continued as well as the effect of the continuous use of seed potatoes grown under irrigation. The investigational work in the field in

carried on principally at Aroostook Farm, Presque Isle, Me.; Holmdel, N. J.; Virginia Truck Experiment Station, Norfolk, Va.; Spooner Branch Station, Spooner, Wis.; Louisiana Agricultural Experiment Station, Baton Rouge, La.; the substation at Troup, Tex.; Oklahoma Agricultural Experiment Station, Stillwater, Okla.; Arkansas Agricultural Experiment Station, Fayetteville, Ark.; and at Eagle, Colo. Very gratifying results have been obtained in the maintenance of high vegetative vigor and yield in members of the Rural group in the long-time growing tests under irrigation at the Greeley station; in fact, the potatoes which are being produced as a result of these tests are eagerly sought by growers for seed purposes. In addition to the segregation of the healthy high-producing strains of seed in several of the important potato-producing regions stock of valuable strains has been secured from high-yielding disease-free seed grown in Canada.

*Potato diseases.*—An important development in the investigations of the past year has been the differentiation of another distinct type of the so-called degeneration disease of potatoes, namely, spindling-tuber, which, like mosaic and leaf-roll, is transmitted from season to season by seed tubers and from plant to plant by aphids. Heretofore this type of trouble has been designated as "running out" or "running long" and ascribed to senescence due to prolonged asexual propagation or to unfavorable soil, climatic, or cultural conditions. It occurs in the leading commercial varieties and spreads about as readily as mosaic. Besides reducing the yield about 50 per cent, the disease affects very materially the marketability and apparently the culinary quality of the tubers and is therefore a worse trouble than mosaic or leaf-roll. Control measures apparently will be the same as for mosaic and leaf-roll.

Further studies of mosaic have shown that there are three distinct types (mild mosaic, rugose mosaic, and leaf-rolling mosaic) and that fertilizers high in nitrogen and potash mask the mottling symptom somewhat but do not reduce the amount of the disease. Control experiments have shown that the percentage of healthy plants increases as the distance from diseased plants increases and that the percentage of infection fluctuates seasonally and regionally with aphid infestation.

Further observations on the relation of leaf-roll and net necrosis have confirmed previous conclusions that net-necrosis tubers produce leaf-roll plants but that not all leaf-roll plants develop from tubers with net necrosis. This disease is apparently much less general in seed-growing sections in the East than mosaic or spindling-tuber. Besides these three distinct types of virus diseases there are combinations of two or more of these types which are also transmitted by aphids.

### SWEET POTATOES.

The variety collection of sweet potatoes which has been maintained by the department for many years is being used as the basis of careful selection and development work, with the idea of producing high-yielding strains of all of the important commercial varieties cultivated both in the northern and southern portions of the sweet-potato producing area. The selection work which has been carried on in connection with the variety collection has resulted in the devel-

opment of excellent foundation stock; in fact, the department's stock of the leading commercial sorts, when placed in comparison with the commercial run of the variety as handled in several producing regions, has invariably given a better account of itself than the local product. Now that the variety studies have been published, it is proposed to use the collection as the basis for careful breeding and selection work. In addition to this, in cooperation with the Office of Experiment Stations through its station at St. Croix in the Virgin Islands, seed of a number of the important varieties of sweet potatoes has been obtained, and seedlings are now being grown from this supply with the hope that sorts more desirable than any now available may be produced. It is impossible to produce and ripen sweet-potato seed in the open in the latitude of Washington, D. C., because of the shortness of the growing season, but under the tropical conditions of the Virgin Islands a seed supply can be obtained.

PEAS.

*Studies of the Alaska variety.*—For two years samples of peas of the Alaska variety, which are used as the basis of a very large percentage of the acreage planted for canning purposes, have been obtained in the open market and grown side by side in the trial grounds. In 1923 the growing tests of Alaska peas comprised 219 samples secured in this way. Of these samples, 11 proved to be true to name with no off-type plants; 16 were off-type only in the slightly greater length of the vines, while the production and character of the pods would admit them to cultivation for canning purposes; and 67 additional samples showed less than 10 plants per rod of row of off-type peas and vines. Of the remainder there were 51 samples which showed from 10 to 25 plants per rod having long vines not characteristic of the Alaska variety. The samples that had more than 25 plants per rod of long vines numbered 39, while 35 samples were either not Alaskas or were so-called "wild Alaskas" or field peas. In this test of 219 samples offered in the open market by the trade 4.6 per cent were high-grade Alaskas, 7.4 per cent showed only off-type vines, and 31.1 per cent had less than 10 plants per rod off-type in character. Of these samples, 94 could be used for canning purposes, but 125 samples were such decided departures from the Alaska type that they could not be successfully handled in commercial plantings by canners.

The results of the tests in 1923 parallel very closely those of 1922 and furnish a fairly true index, it is believed, of the character of the seed being offered to the trade by the commercial seedsmen of the country. It must be borne in mind, however, that while this analysis has been made from the standpoint of the canner, whose requirements are very much more exacting than those of the market gardener or home gardener, it is the large commercial interests, such as the canning industry, that are most seriously affected when the supply of seed falls into one of the categories below the grade which can be tolerated by the industry. The planting of extensive acreages of spurious or off-type Alaska peas in the eastern part of the canning territory during recent years has resulted in very great losses to the growers as well as to the canners. In fact, some of the off-type Alaskas contained field peas which mature with the Alaskas but give an entirely different reaction in processing. The presence

of a small percentage of these peas (Bangalias) in the seed of the Alaska variety, no matter how good it may be otherwise, absolutely ruins the pack, because of the discoloration of the liquid in the cans. High-grade seed true to varietal type is the only insurance against such losses on the part of the grower as well as the canner.

*Pea diseases.*—The investigations of the diseases of canning peas have been continued and extended during the year, the principal object being to find the cause and means of control of pea root-rot, which causes greatly reduced yields in the older districts and is one of the most serious pathological problems of this crop. It has been found that the disease is not carried to any important extent in the seed but is a soil infection which remains in the ground and increases from year to year. A long crop rotation is the only method of control known at present, and as the necessity for such rotations reduces the returns in the intensive pea-growing districts better means of control are being sought. Root-rot has been found to be due mainly to four organisms (*Aphanomyces* sp., *Pythium debaryanum*, *Fusarium martii* var. *pisi*, and *Rhizoctonia solani*).

#### DISEASE PROBLEMS IN TRANSIT AND MARKET.

Cooperation with the Bureau of Agricultural Economics in the pathological phases of the work of food-products inspection has continued. This service has been expanded by the inclusion of point-of-origin inspection in cooperation with 19 States, for which additional inspectors have been trained by our pathologists in the identification of diseases causing transit losses in vegetables. This information has also been given to the growers, shippers, carriers, and receivers of market vegetables through illustrated lectures and a series of printed circulars, of which seven have been prepared. The workers under this project have also acted in an advisory capacity for the inspection service of the Bureau of Agricultural Economics and assisted in formulating those policies in which the plant-disease feature played a rôle. Similar work is conducted in the handling and marketing of fruits.

*Broccoli handling.*—The investigations of the handling of broccoli were carried on in the vicinity of Roseburg, Oreg. The shippers had been experiencing considerable difficulty in getting their product to market in good condition. In many cases the leaves became yellow and dropped, the heads became riced and yellow, and the product was rendered unattractive in other ways. The question as to whether this breaking down was due to improper methods of transportation, to the way the product was harvested and handled, or to poor seed was determined by a series of experiments carried out at Roseburg last winter. In these experiments broccoli which was harvested at different stages of maturity and handled in various ways was placed in an iced refrigerator car on the siding at Roseburg and held 16 days. It was shown fairly conclusively that the troubles the shippers were experiencing were due to the unsuitable varieties grown and the improper methods of harvesting and handling.

## FOREST DISEASES.

### WHITE-PINE BLISTER RUST.

Investigation of the white-pine blister rust has been continued. The method of distinguishing between the white-pine rust and the similar piñon-pine rust, formerly confused with it in the stage on currants, has been improved. Examination of American species of white pine planted in western Europe showed the rust killing large trees in 15 different places. In British Columbia large trees of western white pine were found dying. In many cases trees were killed even before the fungus reached the trunk, as the result of universal killing of the branches by individual infections. These foreign investigations give further evidence of the damage which the disease may be expected to do on longer establishment in this country and especially to the western white pine, which has been found to be more susceptible than the eastern white pine.

Further information has been obtained by field and greenhouse experiments as well as by field inspections as to the species of currants and gooseberries which cause greatest damage to pine and are therefore most necessary to eliminate in selective eradication work. It has been found that all the northwestern species of Ribes which have so far been subjected to infection either in nature or in greenhouse experiments (a total of 16 species) are susceptible to the disease. *Ribes bracteosum* and *R. petiolare*, wild currants, native to the Northwest, are especially susceptible.

Field evidence has confirmed earlier indications that the elimination of cultivated black currants, a cheap and rapid procedure, will greatly delay the establishment of the disease in new territory. The black currant (*Ribes nigrum*) is much more susceptible to the disease than any other species.

Field surveys at the end of the 1921 season showed that unprotected pine areas in the Northeastern States were becoming generally infected and that the volume of æciospore production followed by currant and gooseberry infection and later by pine infection was rapidly increasing. An examination of 53,838 pines on 138 miles of rod-wide strip line and 256 plats in Maine, New Hampshire, Vermont, Massachusetts, and New York showed 16 per cent of the trees infected. In local areas where the disease had been established many years, 60 to 100 per cent of the white pines were dead or dying, and between these areas new infections were generally distributed.

During the past season 20 per cent of the pines on 12 miles of rod-wide strip line in northeastern New York were found diseased, and an extensive study of a white-pine plantation established in 1916 in the same region showed 24 cent infection. In northeastern Pennsylvania the rust was found on currant and gooseberry bushes in Wayne and Lackawanna Counties, but no infected pines were located. In Michigan the blister rust was found on currants and gooseberries in Oakland County, for the first time in the State. Also, three infected planted pines were found in Oakland County and one in Kent County. All the diseased host plants were destroyed. In Wisconsin and Minnesota the disease is not advancing so rapidly as in New England and New York, partly because of the scattered distribution of the host plants, particularly the white pine, and

partly because the rust was not introduced as early as in the Northeastern States, and then in only a few places.

In western North America the blister rust was first found during the autumn of 1921 on pines and currants at several points in southwestern British Columbia. Later it was found in northwestern Washington on cultivated black currants at Sumas, Mount Vernon, Beverley Park, and Port Townsend, and on two planted white pines at Mount Vernon.

Extensive field surveys during the past season by Federal, State, and Dominion scouts show that blister rust is widespread throughout the coast pine belt of British Columbia on both pines and currants and gooseberries. It was introduced there in 1910 or earlier on imported nursery stock. Several large areas were found where the disease is now epidemic on the pines. In one local area 40 per cent of the trees are dead and 100 per cent are seriously infected. The rust was found also with more limited distribution on pines, currants, and gooseberries at Revelstoke and Beaton, east of the dry belt in British Columbia. These points are located about 100 miles from the international boundary in the northern part of the commercial western white-pine belt, which extends into eastern Washington, northern Idaho, and western Montana. Repeated scouting in these regions gave negative results.

No trace of white-pine blister rust was found in the western United States, except in that portion of Washington lying west of the ridge of the Cascade Mountains. In this region the rust was found principally on cultivated black currants on 170 properties within the counties of San Juan, Island, Whatcom, Skagit, King, Pierce, Clallam, Jefferson, Kitsap, Mason, Grays Harbor, and Pacific. In the infected counties 2.1 per cent of the total number of cultivated black currants inspected were found attacked by the rust. Pine stands in this region were scouted intensively, but only a single canker of 1917 origin was located. This was on a planted pine at Blaine, Whatcom County, near the international boundary. The scope of this work was ample to show that the disease was not generally established there on pines and that the infection on Ribes is the result of the general spread of the disease from heavily infected pines in British Columbia.

The general establishment of blister rust in the commercial western white-pine areas will eventually cause severe economic loss unless adequate measures for its control can be developed and applied under western conditions. Owing to the more recent introduction of the disease into western North America, as well as to differences in field conditions, host plants, and climate, these factors must be studied and their proper bearing on the spread of the rust ascertained before the practicability of delaying its progress and the limitations of local control can be fully determined.

### CHESTNUT BLIGHT.

Chestnut blight has spread more rapidly in the Southern States than it did in the North. A large advance infection of the disease has been found covering parts of Greenville County in South Carolina and Henderson and Polk Counties in North Carolina. This advance infection indicates that the death of the chestnut stand of

that part of the country will occur sooner than had been estimated. The Chinese chestnut (*Castanea mollissima*) has been found quite resistant to the blight.

The chestnut and white pines, two of our most important trees from the standpoint of profitable management of forest lands, have been seriously attacked by imported fungi. One is being rapidly destroyed, while in the other case the disease will be controlled only at considerable expense and after very severe losses have occurred. Another of our important trees, the Douglas fir, is threatened by a serious canker which is prevalent on this tree in Scotland. This canker also attacks larch and hemlock. It is entirely possible that this disease is already in this country. The knowledge of forest diseases in the eastern United States is so limited that the fungus could easily have gained a considerable foothold without being reported.

#### WOOD CONSERVATION.

Study of the causes and control of decay in lumber and other wood products is carried on in cooperation with the Forest Products Laboratory of the Forest Service at Madison, Wis. The following are examples of the different lines of industry which are interested and actively cooperating in the work of the branch office: The paper companies on the prevention of decay in both stored wood and pulp; the airplane industry on defects in propellers; the automobile and furniture industries on hidden pathological defects in lumber, especially the interior dote of elm; and the various lumber associations with their blue-stain problem.

During the fiscal year the decay of building timbers has been investigated in Kentucky, Tennessee, Missouri, Arkansas, Oklahoma, Mississippi, Louisiana, and Alabama. The study in Alabama was made at the request of the State commissioner of conservation and in cooperation with him. Articles have been published in trade journals describing the most destructive building-rot fungus of the South and outlining methods of control.

Further experiments on the preservation of ground wood pulp have been made toward improving the methods employed and reducing the cost of preservative treatment. Laboratory tests indicate that one of the new substances under trial may reduce the present cost of preserving pulp from about $2.50 to approximately 50 cents a ton.

The problems involved in controlling or lessening blue-stain in lumber have been studied, and a preliminary field survey has been made in the southern yellow-pine region. Laboratory dipping experiments have been started in a search for a treating solution which will be effective in controlling the staining fungi. While much progress has been made, the waste due to this fungous trouble still aggregates approximately $10,000,000 a year, and further intensive investigation is urgently needed.

### PLANT NUTRITION.

#### LENGTH-OF-DAY RESPONSE.

Through continuing investigations on the effect of the length of day on plant growth it has been found that there is an important interrelationship between the length of day and the temperature level

to which the plant is exposed which undoubtedly influences plant behavior at different altitudes and also may be expected to be a factor of importance in very high latitudes. For example, a large group of plants which are typical biennials when exposed to the usual summer condition in lowlands of relatively long days in conjunction with comparatively high temperatures are caused to behave as annuals where subjected to a combination of long days and a somewhat lower temperature level, a relation such as would usually obtain at high altitudes. Lower temperatures alone, however, do not accomplish this result. On the other hand, the combination of a long daylight period and a relatively cool temperature affects some plants unfavorably. Another feature of the photoperiodic response, of special interest and significance, is the fact that the formative action of the light period may be sharply localized. Thus, in the case of cosmos, by appropriate exposure of different portions of the stem to different day lengths, flowering may be induced in either the apical or the basal portions or even in the middle zone, while the remainder of the stem continues in the vegetative state. Investigation has revealed that the formative action of the light period is associated with definite change in the hydrogen-ion concentration of the cell sap. With the group of short-day plants, abrupt change from long-day to short-day conditions results in a sudden and decided decrease in acidity, which occurs three to five days after the change in the illumination period has been made. This phenomenon is believed to mark the transition from the vegetative to the reproductive type of activity. Abrupt change from a long to a short daylight period also results in a prompt and well-defined increase in total soluble carbohydrate in the cell, accompanied by changes in distribution of soluble carbohydrate between monosaccharid and polysaccharid.

### SOIL BACTERIOLOGY.

*Nitrification of green manures.*—Green manures of different kinds and of different ages applied in different quantities have been tested in the field, in the greenhouse, and in the laboratory. In the greenhouse experiments their effect upon crop production was clearly noticeable for four years. In a heavy clay soil of little natural productivity, the nitrogen availability varied between 30 and 80 per cent, but in a very fertile soil higher returns were obtained. Especially with small applications of manure, more than 100 per cent of the nitrogen applied was frequently recovered in the crops; that is, the activities of the soil organisms became so intense under the influence of the manures that the humus nitrogen present in this soil was more rapidly nitrified than that in the unmanured soil. Accordingly, nitrification tests made in the laboratory with the different green manures yielded results which in some cases agreed well with the nitrogen efficiency recorded in the greenhouse, but in other cases they were much lower, again indicating that more humus nitrogen was used by the manured plants. The field tests showed, in addition, that nearly the same crop increases may occur if the green parts of the legumes grown for green manuring are removed, so that only stubble and roots are left.

The beneficial effect of legumes upon the succeeding crop is only partly due to the plant food that becomes available by the decomposition of surface and root growths of the legumes. Special tests made in the greenhouse showed clearly that the resulting crop increases are frequently higher than they could be if the fertilizing effect alone were taken into account. Leguminous and perhaps other crops exert undoubtedly a favorable influence upon the soil bacteria, and a thorough examination of these almost unknown but evidently important relations between cultivated plants and soil microorganisms has been started.

*Formation of mineral deposits by bacteria.*—In cooperation with the United States Geological Survey the formation of deposits of calcium carbonate by bacteria has been investigated. Two groups, ammonifying and denitrifying organisms, have been found to be active in this respect. They precipitate the carbonate not only from organic but also from inorganic salts of calcium, e. g., calcium sulphate.

*Inoculation of legumes.*—Experiments to determine the necessity for inoculating leguminous crops have been conducted in the following States: Pennsylvania, New Jersey, New York, Ohio, Michigan, Illinois, South Dakota, North Dakota, Colorado, Oregon, Washington, California, Oklahoma, Georgia, North Carolina, and Virginia.

### PREVENTION OF ALKALI INJURY ON IRRIGATED LANDS.

In many districts the chief concern of the irrigation farmer is to prevent the accumulation of alkali salts in harmful quantities in good land rather than to reclaim salty land for use in crop production. The causes that contribute to injury of land by alkali salts are continuing causes and are largely subject to control by the irrigation farmer if they are correctly understood. Unless adequate drainage is provided, the salts carried in solution by irrigation water are left in the soil when the water evaporates or is taken up by crop plants. Under these conditions the soil solution may become excessively concentrated as time goes on, which may result not only in direct injury to growing crops but may also injure the physical condition of the soil. This is particularly true where the dissolved salts are chiefly compounds of sodium. The concentration of the salts of sodium in the soil solution results in reactions with other materials in the soil which increase the tendency of the soil to become puddled and impermeable to the movement of water, and when these conditions obtain it is difficult to remove the excessive salts in the soil solution by leaching.

The salts of calcium and magnesium as they occur in the soil solution are not only less injurious to crop plants than the salts of sodium but appear also to have a beneficial effect on the physical condition of the soil. When the irrigation water is relatively rich in calcium and magnesium the reaction that takes place in the soil appears to result in improving the physical condition and permeability of the soil.

These results indicate the importance of understanding, in any irrigation region where alkali troubles develop, both the character of the soil solution and the irrigation water, so that the irrigation practices may be designed to prevent the excessive accumulation of soluble

salts in the soil, especially if these accumulations are high in sodium compounds. It appears reasonable to expect that even where irrigation water contains relatively high percentages of sodium salts more liberal use of water and more adequate drainage may prevent dangerous salt concentrations.

## SOURCES OF CRUDE RUBBER.

On the basis of a special appropriation for this purpose, more extensive investigations of rubber-producing plants are being undertaken to determine the possibilities of producing rubber in the United States or in adjacent tropical regions. The need of developing other sources of supply is shown by the rapidly increasing consumption in the United States and the danger of supplies from the East Indies being interrupted. About nine-tenths of the world's supply of crude rubber now comes from the East Indian plantations, and about three-fourths of the total supply is used in the United States. Exploring parties have been sent into Central America and South America during the past year to consider both species now known commercially as more or less satisfactory for producing rubber and to assemble such other plants containing rubber as may give promise of experimental development.

*Investigations of Para rubber in South America.*—An expedition has been organized to visit the native rubber forests of Brazil and those of the upper valley of the Amazon in Peru and Bolivia to obtain more definite information regarding the habits and geographic distribution of the Para rubber tree (*Hevea brasiliensis*) and to procure seeds or propagating material of superior stocks of this or other species of Hevea that are likely to be more productive or more tolerant of drought or other unfavorable conditions.

*Rubber experiments in Haiti.*—About 150 acres of different kinds of rubber-producing trees were planted about 20 years ago (1903 to 1905) in the district of Bayeux, near the north coast of Haiti, where they are being utilized for shade in a cacao plantation. These plantings indicate that the local conditions are not unfavorable for the growth of the trees, though tapping has not been done in a manner that would determine the possibilities of commercial production. The plantings include two species of Castilla, with Hevea, Funtumia, Ficus, and Mimusops.

*Habits of the Funtumia rubber tree.*—The behavior of the Funtumia rubber tree in Haiti shows several desirable features that may render it especially adapted for use in reforestation or rubber reserves, if not for commercial planting. The seeds have a large pappus and are carried by the wind, while the seedlings are tolerant of shade and able to grow in competition with other vegetation in waste places. Trees that are cut sprout vigorously from the stumps. The trees are vigorous and the foliage is clean and attractive, not unlike that of coffee. The leaves stand opposite but are slightly unequal in size; but the flowering and branching are alternate, only one leaf of each pair producing an inflorescence or a leafy branch. Seed is produced abundantly from large double pods. Rubber can be obtained by mechanical extraction from the dry bark of Funtumia as well as from the latex.

*Cultural possibilities of balata.*—The balata gum of Guiana, Venezuela, and adjacent regions has been known for many years as an acceptable substitute for rubber or gutta-percha, or even superior for some purposes, but little attention has been given to its cultural possibilities because the growth of the trees was supposed to be very slow. Recent observations in the Canal Zone and in Haiti indicate that the young balata trees develop rapidly and need to be studied from the standpoint of commercial production or for planting in rubber reserves.

*Planting of Ceara rubber in Nicaragua.*—Several plantations of the Ceara rubber tree (*Manihot glaziovii*) in the district of La Paz, Nicaragua, were visited in June, 1923. More than 100,000 trees had been planted about 20 years before, including one estate of 60,000 trees planted in 1901. In the more favorable places the trees had attained a height of about 40 feet and a diameter of 12 to 14 inches, but the returns from tapping did not pay the cost of the operation, and the hope of profit was abandoned several years ago. Much of the rubber had been cut down to make room for pastures of Guinea grass. Also the plantations of Ceara rubber had suffered from the attacks of termites, which destroy the wood of the trees, leaving a weak outer shell which may break down. No plantations of the Hevea or Para rubber tree were found in Nicaragua, but the Ceara rubber is also a native of Brazil and has been confused with Hevea. On account of the long dry seasons in this part of Nicaragua the planting of Hevea would not be recommended, but Ceara rubber was considered promising for dry regions.

*Exhaustion of native rubber in Central America.*—It might be supposed that the most favorable conditions for rubber culture would be found in districts where wild rubber trees are most abundant in the forests. Rubber-planting enterprises in Mexico and Central America have been projected on this assumption regarding the native rubber, overlooking the fact that the native Central American rubber tree is well-nigh exterminated in many districts that formerly produced large quantities of rubber. The native method of tapping is destructive, so that with intensive rubber gathering all the trees of seed-bearing age may be killed, and the forest growth of rubber is reduced or brought to an end. This has occurred notably in the Canal Zone and adjacent districts of Panama that formerly produced commercial quantities of rubber, where the rubber tree is now very rare and in some districts completely extinct. Protection of seed-bearing trees would be necessary in order to maintain the growth of rubber under the natural forest conditions. Merely with precautions for seeding, large quantities of rubber undoubtedly could be grown without other expense in waste lands of Central America and the West Indies.

*Rubber reserves in tropical America.*—Whether it is practicable to establish in any part of tropical America the same system of production that has been developed on the East Indian rubber plantations is one of the important questions, but other possibilities of increasing the production of rubber in tropical America need also to be considered. Some of the difficulties of the plantation system might be avoided if measures could be developed for encouraging the production of rubber by native farmers in tropical America, as in some parts of the East Indies. Also it might be possible to provide

against an interruption of supplies from the East Indies by protecting the native growth of rubber in the forests of unoccupied regions or by planting waste lands. No assurance can be given of the time that will be required to develop practical systems of commercial production in America or that direct competition with the East Indies will become practicable. Premature efforts to promote commercial plantings could only react unfavorably, but the outlook toward commercial planting would be improved by the experience that would be gained in establishing rubber reserves in the Canal Zone or in other accessible regions of tropical America.

*Reforestation with plants containing rubber.*—The need of reclaiming and reforesting waste lands in tropical America is being recognized in several countries, and the use of rubber trees or plants for this purpose is being considered in the study of rubber-production problems in tropical America. The primitive milpa system of agriculture, of cutting and burning new tracts of forest every year to plant corn or other annual crops, as generally practiced in tropical America, is destructive and tends gradually to replace the forests by low brush or open fire-swept grasslands. Large areas of waste lands are found in many parts of tropical America as a result of the use of the destructive milpa system. The reclamation of such lands may be possible through the planting of rubber or other tree crops to replace the grass or scrubby growth of bushes. Systems of agriculture must be taken into account as well as the natural conditions in considering the productive possibilities of a country for rubber or other crops.

## EXPLORATIONS AND PLANT INTRODUCTIONS.

### SEARCH FOR FOREIGN CEREALS AND FRUITS.

During the past year Joseph F. Rock, agricultural explorer for the bureau, has traveled in the remote Province of Yunnan, South China, and in the neighboring portions of Burma. From this little-known corner of the world he has sent to the United States seeds of many new pears and apples likely to prove of value in this country as stocks upon which to graft American varieties, as well as many other native fruits and ornamental plants. From Burma he sent several thousand seeds of *Taraktogenos kurzii*, a tropical tree whose seeds yield chaulmoogric acid, successfully used in the treatment of leprosy. The plants grown from this shipment will be sent to Hawaii and other regions where leprosy is present. In January, 1923, Mr. Rock entered into an agreement with the National Geographic Society, which undertook to maintain him in the field for another year. During this time Mr. Rock, who remains on the department rolls as a collaborator, sends his collections of seeds and plants to this bureau.

Dr. H. V. Harlan, engaged in cereal investigations, was sent to North Africa and India in search of barleys. His collections of seed, including many varieties of wheat and barley, are expected materially to enlarge the range of types of this crop for agronomic testing and for breeding work.

### SAFEGUARDING THE ENTRY OF NEW PLANT IMMIGRANTS.

One of the important functions which the bureau performs is to aid in the effort to exclude foreign crop pests from our shores. Through the Office of Foreign Seed and Plant Introduction, cooperating with the Federal Horticultural Board, an inspection house with quarantine greenhouse facilities is maintained. Seeds, plants, and plant materials of all kinds obtained as a result of agricultural explorations and through correspondence are received, inspected, and treated, when necessary, at the plant-inspection house. Commercial shipments are also received there, inspected, handled, repacked, and reshipped to their respective owners. During the past year 6,000 lots of seeds, plants, and plant materials were received in connection with this work. This material came from many parts of the world, often from remote regions, and has been inspected, handled, and recorded in accordance with the careful plans and system developed. A considerable number of these shipments were for cooperative workers in various offices of the bureau and in agricultural colleges and experiment stations. The same rigid methods of inspection and handling were followed in connection with seeds and plants sent out of the country in exchange for those forwarded to the department. Of commercial shipments received and handled during the year, approximately 800 were recorded.

### PROMISING NEW FRUITS.

*Barouni olives.*—The Barouni olive (S. P. I. No. 12569), introduced from northern Africa, has received much attention from olive growers and packers on the Pacific coast. Because of its large size, excellent quality, and high oil content it appears to be a variety of much promise. A particular feature is its ability to withstand high temperatures in the packing process, thus making possible the production of a high-class ripe olive having the large size which has long been desired.

*Fuyu persimmons.*—The fuyu persimmon (S. P. I. No. 26491), introduced from Japan, has shown much promise and is being planted commercially. Indeed, it seems likely to become one of the leading commercial varieties in the United States. The fruit is never astringent and can be eaten when still hard, a characteristic very rare in the Japanese persimmon. Its shape is ideal for packing and shipping and its color a beautiful golden orange. In quality it ranks among the best.

*Avocado varieties.*—For a number of years the department has been engaged in studying the avocados of tropical America and in procuring the best available kinds for the use of horticulturists in California and Florida, where the cultivation of this valuable fruit is rapidly assuming commercial proportions. A number of Guatemalan varieties introduced in 1916 have come into bearing and are now offered by nurserymen both in California and Florida. Several of them have been planted commercially in the latter State. A set of five varieties from Ecuador, introduced in 1920, is now on trial in both States, as are also several promising sorts from Costa Rica and Colombia. With the exception of the date palm, no other horticultural industry in this country has received the attention at its

very inception that has been given the avocado. American avocado growers are now equipped to proceed with the development of their industry, with reasonable assurance that they have the best available varieties as well as fairly complete knowledge concerning the cultivation of this fruit in other lands. In Dade County, Fla., nearly 2,000 acres are already planted to this crop.

#### MENTHA CITRATA.

Gratifying progress has been made in the introduction of *Mentha citrata*, a plant belonging to the mint family, as a new volatile-oil crop in this country. During the year this plant was grown at Arlington Experiment Farm on a scale large enough to give definite indications of its commercial possibilities. The yield of oil from the plant when distilled was at the rate of 30 pounds per acre. The oil itself is very fragrant and when fractionated yields 50 per cent of linalyl acetate, a compound extensively used by manufacturing perfumers. If grown as a special crop under suitable conditions this plant promises an acreage return equal to that now obtained from other cultivated mints.

### ORNAMENTAL PLANTS.

*National rose test garden.*—The plans for the future conduct of the national rose test garden have been so modified that it is expected that a large number of the varieties of mosses, briers, and centifolias will be eliminated from the garden after the observations of another year. Meantime every effort is being made to complete the records of these varieties so that all may go except those that will be kept as index varieties with which to compare other varieties that may be supplied for test purposes. The species collection transplanted last fall is doing well. Progress is being made in preparing the stocks upon which the tea and hybrid tea roses are to be budded for the variety tests, and steps have been taken to begin the propagation of roses on their own roots. The test will probably also include another set of own-root roses propagated next season.

*Peonies.*—With the peony collection notes were taken this year on the color of the early foliage and also on the duration of the flowering season. As a result of a conference with members of the American Peony Society it is expected that more specific information will be obtained from the collection next year and thus make the collection of more value. Several new varieties were added the past spring, with the prospect that more than 200 others would be added during the fall.

*Chrysanthemums.*—The development of hardy early-flowering autumn chrysanthemums which has been under way for several years is being continued at the present time by the growing of practically an acre of new seedlings. One of these bloomed this season in June.

*Iris.*—Because several of the new European varieties of iris have been added to the collection the past spring, with the prospect of others coming in the near future, it has been determined to continue the iris garden in order to make possible the comparison of these new varieties with those now standard in the American trade.

*Hyacinths.*—For the first time since bulb investigations were begun and probably for the first time in this country propagations have been made from mature mother hyacinth bulbs of our own growing. This marks an important epoch in bulb investigations, for upon the behavior of the propagations made from home-grown mother bulbs depends the future of successful bulb propagation in this country. The difficulty of bringing from abroad healthy well-developed mother bulbs is so great that it is imperative that the mother stock be developed in this country, and if the present effort proves successful the fundamental basis for successful bulb propagation will have been laid.

*Tulips and narcissi.*—The propagations of tulips and of narcissi which have been carried on both at Bellingham, Wash., and at Arlington Experiment Farm are proving very satisfactory, and the young stock is making satisfactory development. Acting on the suggestions from this bureau, several bulb growers are making use of forced florist bulbs to excellent advantage for their initial propagations, such stock having been demonstrated to be quite satisfactory for the purpose. The possibility of using this material is proving of great benefit because of the high cost and unsatisfactory character of stock received through importation. Only healthy bulbs which have proved themselves capable of throwing good flowers should be used for the purpose.

*Easter lilies.*—There will be as many as 15,000 to 20,000 Easter lily seedling bulbs from one commercial source, but this is a good start, which following the small but satisfactory crop of last year chronicles the real beginning of the home production of these bulbs. Beside this a number of florists are this year growing their own seedlings for winter forcing. At Bellingham, Wash., half an acre of tulips, 1 acre of daffodils, and about half an acre of lilies and other miscellaneous stocks have been grown. In these investigations there are new stocks of lilies, Galanthus, daffodils, and about 15 new varieties of bulbous iris.

## SEED INVESTIGATIONS.

*Seed testing.*—During the fiscal year 1923 the seed-testing laboratories received and examined 27,370 samples of seeds. Of these, 13,755 came to the Washington laboratory and 13,615 to the five branch seed-testing laboratories maintained in cooperation with State institutions. These samples represent both vegetable and field seeds from farmers, seed dealers, and investigators, to whom reports of analyses were sent showing the presence of weed seeds and worthless material, or germination, or both, as requested. Through this service the work of the seed-testing laboratories is immediately applied to practical agriculture. In addition to the above, 8,490 lots of vegetable seeds were purchased and tested for germination. The results of these tests will be published. Some of these seeds (garden peas and beets) were also tested in the field for trueness to name.

The study of the characteristic weed and other seeds occurring in crop seeds grown in different localities in the United States and in foreign countries has been continued, and the results will soon be ready for publication. As in previous years, analysts from seed

houses have been given the opportunity to become familiar with the methods and practice of seed testing during July and August. In this way testing as carried on by the seed trade is rapidly improving.

*Enforcement of the seed-importation act.*—The enforcement of the seed-importation act involved the testing of 1,230 samples of forage-plant seeds offered for import into the United States. Imports of the various items vary greatly from year to year both in extent and as to country of origin. The outstanding feature of the imports of 1923 was the small quantity of red-clover seed, less than 500,000 pounds, as compared with 10,000,000, 16,000,000, and 19,000,000 pounds, respectively, for the three previous years. The general quality of imported foreign plant seeds subject to the seed-importation act has continually improved, both with reference to germination and relative freedom from weed seeds or other foreign matter.

*Seed-vitality investigations.*—Particular attention has been given to the uncertain germination of cotton seed grown in Texas and adjoining States. Methods for germination under laboratory conditions have been worked out, and the varying field stand obtained from planting this seed has been studied under a wide range of soil and climatic conditions.

Further studies have been made on the physiology of dormancy in seeds, which indicate the reason why certain seeds germinate at particular seasons of the year. This has an important bearing on both seed testing and crop production.

*Adulterated-seed investigations.*—During the spring of 1923 samples of seed of orchard grass and hairy vetch were collected, but there appeared to be few lots either adulterated or misbranded. An examination of crimson-clover seed offered by the trade before the 1923 crop was available showed many lots of poor germination and some that were worthless for seeding purposes.

## CONGRESSIONAL SEED DISTRIBUTION.

During the fiscal year 1923, 11,891,049 packages of vegetable seed and 2,414,080 packages of flower seed, or a total of 14,305,129 packages, each containing five packets of different kinds of seed, were distributed on congressional and miscellaneous requests. There were also distributed 14,500 packages of lawn-grass seed and 10,939 packages of imported narcissus and tulip bulbs. The seed and bulbs were purchased on competitive bids, as heretofore. Each lot of seed purchased was thoroughly tested for purity and viability before acceptance by the department, and a test of each lot was conducted on the trial grounds of the department to determine trueness to type.

The work of packeting, assembling, and mailing the vegetable and flower seeds was done by a private contractor at a price of $1.988 a thousand packets, including the furnishing of the packets and envelopes.

No appropriation for this activity having been made for the current fiscal year in accordance with the recommendations of the department, it was terminated on June 30, 1923.

# REPORT OF THE FORESTER.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
*Washington, D. C., October 4, 1923.*

SIR: I have the honor to transmit herewith a report of the work in the Forest Service for the fiscal year ended June 30, 1923.

Respectfully,

WILLIAM B. GREELEY,
*Forester.*

HON. HENRY C. WALLACE,
*Secretary of Agriculture.*

## NATIONAL FOREST POLICY.

Since last year's report the condition of the country in the matter of its forests has become still clearer. A new study of the whole situation made by the Forest Service revealed more definitely how the public policy should be shaped. Two national problems are involved—land use and timber supply. Down to about 1880 land clearing for agriculture more than kept pace with lumbering, but since that time virgin forests have been cut off under the tremendous demand of a vigorous, growing, and increasingly industrialized Nation much faster than the advance of farming could convert the stump lands into cultivated fields. Except in the South and West, in the last census decade the area of improved farm land was either practically stationary or decreasing. Lumbering adds to the cut-over area at the rate of about 10,000,000 acres a year, but what of this goes into farms is almost offset by abandonment of cultivation elsewhere. Eighty million acres of idle land not in demand for agriculture have become a dead weight on the regions in which they have accumulated.

On the other hand, the eastern and most populous part of the country has already begun to suffer the pinch of timber scarcity and high lumber prices in consequence of forest depletion. The remaining virgin timber in the South and far West still enables us to meet our needs for high-grade lumber, but at a steadily rising cost. Second-growth eastern forests eke out the supply; but we are draining our forests, East and West, of a total of 25,000,000,000 cubic feet of wood annually, while growth replaces only 6,000,000,000. Our future needs must be met from our own forests, and substitutes and economies in utilization will only partially offset the normal increase in demand as population increases. We should, if possible, produce permanently as much wood as we now require. The present

annual growth could be increased to about 14,000,000,000 feet, or a little over half our present requirements, if all our forests were given adequate protection against fire and elementary practices of forestry were introduced. By intensive forest management, comparable to the best European practice, our total area of forest land could be made to grow 27,000,000,000 cubic feet annually, or enough to take care of our present consumption and afford a little surplus.

The agricultural needs of the country will not make necessary the decrease of our present forest-land area of 470,000,000 acres in order to produce food. This land should be brought under management and, where necessary, reclaimed through reforestation as quickly as possible, since at best the country must pass through a considerable period of timber scarcity before new stands of merchantable size can be grown on the cut-over lands.

Recents developments in Canada raise the problem of timber supplies from another angle. In June, 1923, the Canadian Parliament amended the export act to authorize the Governor in Council to place an embargo upon the export of pulpwood from privately owned lands in the Dominion. This authorization, if carried out, would extend to all privately owned lands the embargo now in effect upon the Crown lands of several of the Canadian Provinces most important to the United States from the standpoint of pulpwood supply.

Imports of pulpwood from Canada for a number of years have normally exceeded 1,000,000 cords out of an average annual consumption in the United States of 5,400,000 cords during the past five years. An embargo upon Canadian pulpwood would be serious because the paper-mill capacity in the Northeast and the Lake States exceeds the existing supply of domestic timber. The action taken by Canada is simply another indication of the growing stringency of timber supply in North America.

As a result of the threatened embargo, the pulp and paper industry has requested the Forest Service to make a survey of the raw materials available for the paper industry in the United States. An important feature of this survey is to determine our resources for growing pulpwood, with a view to creating a perpetual source of raw material on American soil.

With only about 21 per cent of the country's forest lands in public ownership, a number of the States, as well as the Federal Government, are moving for the extension of publicly owned forests. Already 200 municipalities, including cities, towns, and counties, own approximately 450,000 acres of forest land, held primarily for water supply and to a limited extent for timber growing and recreational purposes. Nineteen States have established State forests, totaling about 5,500,000 acres, of which New York has nearly 2,000,000 and Pennsylvania slightly over 1,000,000 acres. For the purchase of State forests, New York in 1916 authorized a bond issue of $7,500,000, and in Pennsylvania a bond issue of $25,000,000 for the same purpose is proposed.

The State of Washington has just adopted a unique purchase method, which is self-supporting, in that the bonds, designated as State forest utility bonds, which are authorized to be issued for the purpose, impose no general obligation on the State as to either principal or interest. Forest lands can be acquired either through exchange

for such bonds or by purchase with the money derived from the sale of bonds, and the bonds can not mature before the time necessary to grow a merchantable forest on the lands acquired. Washington has also adopted the policy of designating as State forests the land it now owns suitable chiefly for the production of timber, which totals about 800,000 acres.

In Indiana a beginning has been made through the establishment of a contingent fund for various public-forest activities, including the purchase of land for State forests, the fund being used only upon the authority of a committee composed of the governor and certain members of the legislature.

While these and other States are going forward in the extension of public-forest ownership, the National Government is lagging behind. The purchase of less than 81,000 acres under the Weeks Act during the year marked the lowest ebb in Federal acquisition of forest lands since the policy was initiated in 1911, with the exception of one year during the World War. Over 4,500,000 acres should be acquired to complete the program of protection on the watersheds of navigable streams which has been approved by the National Forest Reservation Commission. There is also a strong demand that the Federal Government blaze the path of forest restoration in the big black belts of denuded land, where tree planting must be employed extensively, by acquiring key areas as national forests. Public sentiment is urging more and more that the National Government assume a larger direct part in reforestation, by the acquisition of land where reforestation is difficult or costly or where timber production can be combined with the protection of valuable sources of water.

Private forest owners are giving more and more attention to the growing of timber. Particularly is this so in the Northeast, where economic conditions are the most favorable and protection against forest fires in general the most complete; and it is true not only of the large timber tracts but also of the farm woodlands, which comprise about one-third of our total forest area. Owners of cut-over pine lands in the Southeast are beginning to appreciate the possibilities for satisfactory returns from their second growth, and there is a distinct movement initiated by lumber companies to solve their cut-over land problem by classifying the lands and growing timber crops on those not suited for farming.

In order to place the timber supply for its business on a permanent basis, a large manufacturing company has recently purchased several hundred thousand acres of forest land in Michigan and Kentucky. While harvesting the mature crop of timber, this company is leaving the young trees and protecting the lands cut over.

Lumber companies producing 65 per cent of the cut of redwood in California have initiated a system of reforesting their logged-off lands in which young redwood trees grown in nurseries will be planted to the extent necessary to supplement natural reproduction.

Recent years have seen a considerable expansion in the scale of forest-tree planting. The stimulus has been supplied very largely through the policy adopted by some of the States of distributing young trees. Twelve of the States maintain forest-tree nurseries, which grow, in addition to the stock for planting on State-owned lands, about 12,000,000 trees for distribution yearly to private own-

ers. New York has the largest forest-tree nursery in the United States; this and two other nurseries have a combined yearly capacity of 15,000,000 young trees ready for field planting. Pennsylvania distributes to private owners about 4,000,000 trees annually at a low charge.

The farm woodlands represent a great opportunity for development under modern extension methods. Already enough has been done to demonstrate that farm-raised timber is capable of taking a place of importance alongside of other agricultural crops. This is especially apparent when it is realized that forest land on farms aggregates 150,000,000 acres, or about one-third of the total forest area of the United States.

The extension service of the Department of Agriculture has developed through its county agricultural agents and local project leaders an educational machine which spreads like a vast network over the entire country. It comes in intimate contact with a large percentage of the woodland owners, and because of the character of the organization makes possible the widespread influence of a comparatively few leaders.

Extension methods should increase the volume of timber produced, and within a comparatively few years, through practicable methods of conservative cutting, they should materially improve the quality of farm-grown timber. Hand in hand with increased production there must develop a service dealing with the values of timberland products and suggestions for more satisfactory marketing. Such a program gives promise of increasing the annual returns to the farmer and greatly relieving the impending timber shortage.

There has been a rapid rise in the value of timber in the United States, particularly in the Eastern States, whose virgin stands are largely depleted. The commercial pressure for timber growing is steadily becoming stronger. Many indications point to the conclusion that timber growing as a private enterprise is rapidly becoming feasible in the regions more accessible to the principal markets and having favorable natural conditions as to the rate of forest growth and the cost of securing it. In these regions, which ultimately will embrace the greater part of the forest lands in private ownership, there is no necessity for the assumption of timber growing as a public activity in any wholesale way. It will be the wiser course to give free play to the commercial impetus already evident by making the growing of timber a more secure and attractive business.

Organized forest protection with public financial cooperation will greatly reduce one of the principal hazards confronted by the timber grower. An equitable adjustment of taxes on growing forests will reduce or at least more exactly define a second handicap which now deters many business men from commercial reforestation. Forest planting is seriously held back by the lack of nursery stock available at costs which justify its use on a large scale, a lack which public agencies might well supply. The development of technical forestry practice adapted to the enormous range of conditions in the United States by research and its dissemination among the timber growers or possible timber growers of the country will meet another real need of the present situation. It will be the part of wisdom to concentrate public efforts at the present time upon these

obvious measures, which will go far toward bringing up the growth of wood in the United States to a volume more commensurate with our present requirements, together with the extension of public ownership of forest lands in the types and localities where the task is beyond what may reasonably be expected of private ownership.

Federal legislation covering these four or five essential points was proposed during the last Congress and received the indorsement of the President. The nation-wide inquiry now being conducted by a select committee of the United States Senate not only has been fruitful in bringing out the specific forest conditions and problems in the several regions, but also has brought to light in a striking fashion the extent to which many owners of timberland in nearly all parts of the country are ready to engage in the business of growing timber, if public aid can be extended in the protection of forest lands from fire and in the adjustment of forest taxes. The investigation conducted by the Senate committee is one of the most helpful and stimulating steps that the National Government has taken in attacking the reforestation problem of the United States as a whole, and it is disclosing beyond doubt or question that the time is at hand for enormous progress in timber growing if public agencies will give the landowner a fair chance. This should be the aim of the next step in our national forestry policy.

## FORESTRY IN ALASKA.

The use of the timber resources of the national forests in Alaska has been increasing as the forest industries of the Territory have steadily developed. There was cut under commercial sales on these national forests during the calendar year 1921, 14,316,000 board feet of timber; during the calendar year 1922, 23,943,000 board feet; and during the first half of the calendar year 1923, 18,809,000 board feet, with every indication that the cut for the full calendar year will largely exceed that of any previous year. Not only has the cutting of national forest timber for local use been increasing, but there has been a continuation of the export of the better grades of lumber to the markets of the United States, to Australia, and to Europe. The small pulp mill already built on the Tongass Forest resumed production in 1922, and has been making frequent shipments of pulp to paper mills in Washington and California.

At the close of the fiscal year the Forest Service was advertising for sale 334,000,000 cubic feet (equivalent to approximately 2,000,000,000 board feet) on the Tongass National Forest in response to an application from a firm which proposed to build a pulp mill on Thomas Bay, utilizing one of the best water-power sites in southeastern Alaska. A satisfactory bid and deposit were received from the applicant, and the timber has been awarded under a contract which requires the construction within the next two years of a pulp or paper mill of at least 100 tons daily capacity.

The preliminary examination of the water-power resources of the Tongass National Forest, in cooperation with the Federal Water Power Commission, was completed, and a bulletin is ready for publication which will make available in convenient form the known data on the water powers of the Tongass Forest suitable for the manufacture of pulp and paper. Water powers in addition to those

already examined are certain to be discovered, but it is already known that over 400,000 horsepower, in units up to 32,000 horsepower, awaits development. The Forest Service has in preparation a companion bulletin which will likewise make readily available the data on the timber resources tributary to these water powers.

The steady development of the use of the Alaskan national forests is in keeping with the Alaskan program enunciated by President Harding this summer. After he had personally investigated conditions in the Territory, he summarized his conclusions in a speech at Seattle, expressing his conviction that Alaska is growing normally, with the kinds of population, industries, and social conditions which will bring a permanent prosperity rather than a temporary boom with quick exhaustion. He recognized that the development of Alaska is an economic process, and that the rate of development depends on the world's markets for the products of the Territory. No panacea, he declared, can bring sudden or magical industrial development. He considered Alaska as an integral part of the United States, to be developed in harmony with our political and social traditions and in harmony with our national policies as to natural resources, and was convinced that under the wise application of those policies a considerable part of the Territory should be ready for statehood at no distant time. President Harding pronounced himself in favor of a continuation of sympathetic administration of Federal affairs in the Territory, with the local officers given as much authority and responsibility as possible in carrying out the coordinated general policies of the National Government. He specifically approved the present policies for the development of industries based on national forest timber, since they offer every reasonable encouragement to capital and involve limitations only to the extent necessary to insure permanency and the sustained productivity of the forests. Concerning the present form of timber contract offered prospective pulp and paper manufacturers he said: "I venture, with some knowledge of conditions in paper-making countries, to state that no better contract, indeed none so good, can be secured in any of them."

## THE PERSONNEL OF THE FOREST SERVICE.

It is necessary again, as in several previous reports, to call attention to the nature and importance of the problem that the Forest Service still encounters in the matter of personnel. This problem concerns particularly the field force. For the efficient discharge of its public responsibility in national forest administration the service must have a capable, trustworthy, and trained corps of forest officers. Not only must they be carefully selected and specially qualified for unusual, exacting, and varied tasks, but they must also, as a body, possess enough experience to give continuity and stability of policy, and they must be thoroughly imbued with the spirit of public service.

The work of administration simply can not be carried on in the long run without a forest personnel of suitable make-up. If it is a shifting, unseasoned force, if its members do not measure up to high standards in ability and character, if they have not been well trained for their specific tasks, and if their morale is not kept up, the whole national forest enterprise is impaired.

It is not merely that a field force lacking in competence, experience, or fidelity and enthusiasm will be relatively ineffective, nor is it

sufficient to say that the field men are the men with whom the public primarily deals and through whom the system of regulation is applied, and that therefore inefficiency at this point is particularly serious. The question is not one of a greater or less degree of efficiency, but of success or breakdown in a vital matter. With poor forest officers the whole system of administration will fail to secure the necessary public approval and cooperation. The national forests can not be run on bureaucratic lines. While their use must be governed by sound technical knowledge, it must equally meet and satisfy community needs and demands. The forest officer must be able to command the confidence as well as the respect of his local public in order to accomplish his task, and while applying the principles and maintaining the standards prescribed for him by his superiors, he must win approval and support for the undertaking in his hands or he will be the resident representative of a distant and impersonal bureaucracy which does not serve but rules. National forest administration must be a success on the ground and in the judgment of those who come into first-hand contact with it.

The public expects, and in the nature of the case has a right to expect, much of the forest officer. In its eyes he is first and foremost a business man. He must be able to deal understandingly and tactfully with the users, who correspond to the customers of a private concern. He must also be able to plan, direct the work of others, and get results. He must not lack in firmness on occasion, and must be a good negotiator. With tact and sound judgment he must above all combine unimpeachable integrity. The receipts for use of the forests now bring in over $5,000,000 annually, with operating expenses nearly the same, and the total disbursements, inclusive of road building by the Forest Service and other improvement activities, exceed $7,000,000 annually. Forest officers have therefore large financial responsibilities. Their decisions affect the interests of a multitude of individuals. The number of transactions in connection with uses of the forests involving money payments to the Government runs between 60,000 and 70,000 a year. Obviously, the men who make these decisions and conduct these transactions must be beyond influence by favoritism or thought of possible gain for themselves.

On the technical as distinguished from the business side of their work there are further requirements. Their performance as technical men can less readily be judged by the public, but it is not less important to the public, for on it depend the permanence and maximum future productiveness of the forest resources. It concerns efficient and economical protection of the timber growth against fire and other destructive agencies; its renewal and improvement through right methods of cutting; the perpetuation and improvement of the forage resources under intensive range use; the protection of water sources, a fundamental matter affecting all forms of use; intelligent, sympathetic, and skillful coordination of the varied services of the forests to a multiplicity of local needs—to settlers and farmers, stockmen, miners, rural and urban population requiring recreation opportunities, tourists, all sorts of business enterprises, community interests in road and trail development, etc.; and the conservation of fish, game, and other wild life. Nor is this all. The duties of

forest officers as technical men include also leadership in informing the public concerning the purposes and methods of the work, both in order that the public may be able to judge intelligently whether or not its property is being well handled and in order that wide application of the principles of forest and range conservation may be brought about off as well as on the forests. In short, the requirements along technical lines are no less important and exacting than those which forest officers must possess as business men.

To maintain a field force capable of giving the public the service that it expects and should have has always been a primary concern of the Forest Service and always will be. In many ways the task is essentially the same as that which any large business organization encounters in maintaining an efficient personnel. Were this all that is involved there would be no particular reason for dwelling on the subject. But the problem is not purely an internal one, for the reason that it can not be adequately met without relief from conditions that can only be dealt with through legislation.

For years there has been a continual drain of experienced and the most effective men, due to low pay. The Forest Service has been a training school and recruiting ground for private enterprises. To some extent this is bound always to be the case, and within reasonable limits affords no ground for concern. It is not to be expected that Government employment will hold permanently all whose retention in the public service would be advantageous. But conspicuous underpayment in comparison with the responsibilities involved and what may be termed the going market value of the type of men and kind of training required has really serious consequences. It is uneconomical in the long run, for it takes both time and money to select and train new men constantly for positions in which they can not at once reach a full output; it impairs efficiency, for the same reason; and it makes much more difficult the maintenance of morale, which can not but suffer if too large a part of the force is new, while the enthusiasm and energy of older members are sapped by a sense of injustice, lack of due recognition, and often struggle to make ends meet.

The essential remedy is the carrying through of reclassification of all field positions along such lines that the salaries to be paid will be adequate and just, and provision for the actual payment of such salaries next year.

The handicap imposed through inability to hold good men to the degree necessary for efficiency (and in the long run for economy, too) is made worse by the fact that the Forest Service is at present unable to give field men such training in the technical features of their work as they need to do that work properly. It is sometimes assumed that when new men are taken on through appointment following a civil-service examination they must be fully qualified to meet all the requirements of their jobs, and that additional specialized training beyond that gained in the course of the day's work need not be given them. The assumption is untrue. Not only is specialized training of a kind not to be obtained outside the service necessary to fit recruits fully for their duties, but there is need also to fit those in the lower ranks of the service for higher positions. Something broadly comparable with the methods of training and instruction provided in the Army should be permitted. The immediate

need is for annual instruction camps for the training of rangers in the things they need to know how to do in order to handle successfully their own jobs in fire protection and general administration.

There is also a handicap imposed by the fact that the appropriations now made for the Forest Service preclude the taking in each year of more than a very few men technically trained in forestry and grazing. As older men who entered the service with such training leave, the tendency under present conditions is toward a smaller percentage of professionally trained foresters in the administrative force. Such a tendency, if continued, can not but lower the standards of work. Already the situation is distinctly disadvantageous. Enlargement of the available force of trained specialists is therefore an immediate need.

As the demand for the timber and forage of the national forests increases more and more intensive use will be necessary, and professionally trained men will be required in correspondingly greater proportion. Nevertheless, for years to come men of outstanding ability who have entered the Forest Service without professional training should be able to look forward to positions of major responsibility. It would be a great misfortune if this were not true, for the service has need of the best leadership that can be developed from its entire personnel. Some of the highest positions are now held by men who have climbed the ladder from the ranger ranks. They have been progressively educated as foresters in the practical school of experience. Nothing is more fundamental than that the door should be kept open to ability and that the methods of personnel management should be such as to assure both the fullest possible development of the personnel available and, from the standpoint of the men themselves, prospects that encourage ambition and effort. As a corollary to this, there must be absolute assurance that merit alone determines promotion, and that the forest officer who does his work as it should be done, with an eye single to the service of the public interests, will be secure in the tenure of his position, whatever that may be. The public enterprise in forestry can make good only on condition that it be kept always free from influence by political considerations in the narrowest sense of the term, and one of the greatest obstacles to progress in the development of forestry on the part of the individual States is the fact that public opinion does not always demand this essential to the creation and maintenance of an efficient technical organization faithfully serving the common welfare.

As is shown in the next section of this report, the national forests are already virtually self-supporting, and from now on they may safely be counted on to return to the Treasury a net revenue in excess of their operating cost, though no small part of that cost is incurred on behalf of public services of a nonrevenue-producing character, such as watershed protection and recreational use. Further, the cost of maintenance of the regular protective system as well as emergency expenditures for fire fighting are mainly not operating costs, strictly speaking, but charges against the time when the stands of timber in regions not yet opened up will come into demand. Private timberland owners would capitalize such charges as carrying costs. The less-developed forests and those which are maintained primarily for watershed protection and will not be self-supporting for a long time, if ever, create operating deficits which

are at present just about balanced by the net operating revenue obtained elsewhere. In addition, considerable expenditures are made yearly on the forests for their betterment and development in the form of new roads and trails, buildings, range improvements, and investigations looking to larger and more intensive use. The fact that expenditures of this kind, amply justified on business grounds and making possible greater revenues in the future, bring the total expenditures of the Government on the forests approximately a million dollars above the current receipts should not be permitted to obscure the basic situation. The forests carry themselves now as operating public utilities, and in another year or two will more than carry themselves. Under these conditions there is excellent ground for asking the relatively insignificant increases necessary to maintain the personnel whose efficiency directly affects the income from the forests as well as their value to the public.

## NATIONAL FOREST RECEIPTS AND EXPENDITURES.

The receipts from the national forests for the fiscal year were as follows:

| | |
|---|---|
| From the use of timber | $2,721,876.20 |
| From the use of forage | 2,341,485.85 |
| From miscellaneous uses, including the use of land, water-power sites, etc | 272,456.08 |
| Total | 5,335,818.13 |

A portion of this amount represents grazing fees for the fiscal year 1922 which were collected in 1923 under the deferred-payment system. Since it is probable that an equal amount will be collected in the fiscal year 1924 on account of 1923 grazing fees, the total of $5,335,818.13 may be taken as representing substantially the gross revenue derived from use of the forests for the year covered by this report.

Compared with the actual receipts for the previous year, the total given above shows an increase of about $270,000; but, as was explained in the report for 1922, the showing of receipts from grazing in that year exceeded by almost $800,000 the estimated amount paid or due for the actual use of the range for the period. Deferred payments of grazing fees have affected the receipts statements of the last three years. Previous to 1921 payment of the fee was always made before the stock entered the forests, and the receipts of successive years were comparable. Correcting the figures of actual grazing receipts for the three years 1921–1923 to show as nearly as possible what each year's business should be credited with, they were as follows:

| | |
|---|---|
| Total grazing fees paid or due for fiscal year 1921 | $2,415,618 |
| Total grazing fees paid or due for fiscal year 1922 | 2,166,347 |
| Total grazing fees paid or due for fiscal year 1923 | 2,341,486 |

A corresponding correction of the total of receipts from all sources for the same years gives—

| | |
|---|---|
| For the fiscal year 1921 | $4,468,940.00 |
| For the fiscal year 1922 | 4,271,902.82 |
| For the fiscal year 1923 | 5,335,818.13 |

The high-water mark of receipts prior to 1923 was set in 1920, when the total was $4,793,482. The 1923 receipts, therefore, rep-

resent an actual increase in revenue-producing business over 1922 of more than $1,000,000 and over the previous record year of more than $540,000.

The total was nevertheless below what would have been obtained under normal conditions in the livestock industry. As the grazing business reattains its normal footing, the receipts from this source will be somewhat greater, and there is a certainty of steadily growing receipts from timber sales. As is shown by a comparison of the 1923 receipts with the following statement of expenditures for the same year, the forests are now bringing into the Treasury considerably more than their operation is costing if special expenditures for fire suppression, for improvement construction, and for other activities looking to the betterment of the properties or undertaken in anticipation of future business are excluded.

*Approximate expenditure of Forest Service appropriation, 1923.*

| | | |
|---|---|---|
| Protection and administration of the national forests | | $5,133,382 |
| Fighting fire which could not be suppressed by the regular protective force[1] | | 250,000 |
| Classification, survey, and segregation of agricultural land, and accomplishment of authorized land exchanges | | 60,000 |
| For the construction of sanitary facilities and for fire-preventive measures of public camp grounds | | 10,000 |
| Planting of 7,500 acres on nonproducing land, maintenance of nurseries, and experiment in tree planting | | 125,640 |
| Permanent improvements, such as buildings, bridges, trails, telephone lines, drift fences, and water improvements[2] | | 425,000 |
| Estimating the amount and fixing the minimum value of timber for sale | | 62,500 |
| Examination of intensively used ranges with a view to increasing their productivity by more scientific management of stock and forage | | 37,500 |
| Investigations: | | |
| Forest products, including the Forest Products Laboratory at Madison, Wis. | $340,000 | |
| Silvicultural | 85,000 | |
| Range and forage plants | 35,000 | |
| | | 460,000 |
| Recording, digesting, and disseminating the results of scientific and technical work | | 31,280 |
| Total | | 6,595,302 |

The total given above exceeded that of the previous fiscal year by $46,000, or 0.7 per cent. By individual items the changes from last year were as follows:

| | |
|---|---|
| For the protection and administration of the national forests | $6,000 |
| For the construction of sanitary facilities and for fire-preventive measures on public camp grounds | 10,000 |
| Planting of nonproducing lands, maintenance of nurseries, and experiment in tree planting | 5,000 |
| Permanent improvements | 25,000 |
| Investigations in forest products | 15,000 |
| | 61,000 |
| Less decrease for classification, survey, and segregation of agricultural land | 15,000 |
| Net increase | 46,000 |

[1] An additional emergency appropriation of $375,000 was required for the purpose.
[2] Of this sum, nearly half is required for the maintenance of existing improvements used in the protection and administration of the national forests.

Expenditures for fire fighting have made deficiency appropriations necessary for 8 out of the last 10 years. Congress has preferred to make a relatively small fund available in advance for meeting fire emergencies and to supply whatever additional amounts were required through deficiency appropriations. This has lessened initial appropriations, but it has had certain drawbacks. It is now urged that fire-fighting deficiencies be met out of regular appropriations. The average cost of emergency fire prevention and suppression paid from the special fund and from deficiency appropriations for the past three years has been $708,000. To cut down the present expenditures on other lines of work during the summer months—the active field season—sufficiently to create the contingent fund required not only would necessitate refusing new timber-sale business but also would cripple the whole administrative and protective organization. In other words, if the necessity of deficiency appropriations in all but the most favorable seasons is to be avoided, the special fire-fighting fund available for meeting emergency conditions should be materially increased.

There is need also for a change in the law that will make the emergency fire-fighting fund available immediately upon passage of the appropriation act. In the average season slightly over $100,000 is spent for spring fire fighting, but if the fire season opens late very little may be required. In the past it has been necessary to guard against being faced with emergency conditions just when there are no longer any funds whatever with which to meet them, by seeking a sufficient deficiency appropriation to afford a margin against contingencies. In effect this amounts to partially replenishing the special fire-fighting fund in years in which it has been exhausted early in anticipation of needs that may not develop. If the emergency fire fighting for the following year can be drawn upon for spring fire fighting, no obligation of Treasury funds for this purpose in excess of actual needs will be required, and no deficiency appropriation will be necessary for anything but expenditures already made.

## THE NATIONAL FOREST PROPERTIES.

At the close of the fiscal year the net area of national-forest land was 157,236,807 acres, and the gross area, which includes interior holdings not in Government ownership, was 182,099,802 acres. The net area increased during the year 399,525 acres; the gross area increased 299,805 acres, of which, however, 47,514 acres are represented by recomputations of existing areas based upon more exact surveys and projections.

The total area added to the national forests by Executive orders or proclamations was 408,622 acres. Specifically the additions were as follows: Carson National Forest (New Mexico), 124,247 acres; Fillmore Forest (Utah), 10,268 acres; Lemhi Forest (Idaho), 254,744 acres; Manzano Forest (New Mexico), 16,608 acres; Michigan Forest (Michigan), 435 acres; and Powell Forest (Utah), 2,320 acres. The Lemhi addition was authorized by specific act of Congress as the result of long-continued effort on the part of local residents to have the land placed under national-forest administration. The Powell addition involved a part of the land subsequently embraced within the Bryce Canyon National Monument. The actual eliminations

aggregated 156,331 acres. Of these by far the greater proportion—116,220 acres—were made to clear list lands selected by the States under exchange agreements, as follows: In Montana, from the Blackfeet Forest, 57,198 acres, and from the Flathead Forest, 32,185 acres; in Washington, from the Columbia Forest, 19,018 acres, and from the Colville Forest, 7,770 acres; in South Dakota, from the Harney Forest, 49 acres. The remaining eliminations, amounting to 40,111 acres, were designed either to exclude lands not chiefly valuable for national-forest purposes or to promote the adjustment of valid claims, or, in Alaska, to allow entries under the trades and manufacturers act. Specifically, these eliminations were as follows: From the Angeles (California), 295 acres; the Carson (New Mexico), 10,393; the Fillmore (Utah), 10,161; the Harney (South Dakota), 160; the Jefferson (Montana), 401; the Leadville (Colorado), 1,596; the Lemhi (Idaho), 6,568; the Missoula (Montana), 320; the Powell (Utah), 5,100; the Rainier (Washington), 2,730; the Routt (Colorado), 2,318; and the Tongass (Alaska), 69.

Withdrawals for national forest purposes reached their peak during the fiscal year 1909. There ensued a period of systematic and analytical determination of the value of the reserved lands for forest purposes, with the result that during the past 14 years 26,631,586 acres have been eliminated from the national forests. While the boundary changes were thoroughly effective in excluding from national forests the lands better adapted to other purposes, statutory restrictions generally barred the adding of lands chiefly valuable for timber production. Even to-day many of the present national forest boundaries are unsatisfactory in that they embrace only parts of the natural forest units which, in the public interest, should be under protection and management. Many of the circumstances which formerly precluded additions of unreserved and unappropriated public forest land have lost their importance and there is now no substantial reason why the unreserved and unappropriated public lands chiefly valuable for timber production or watershed protection, estimated at 4,000,000 acres, should not be in national forests. Neither is there any substantial reason of public interest why revested lands aggregating 1,500,000 acres chiefly valuable for timber production should not be in forests. The present status of Indian lands, chiefly valuable for timber production, justifies a separate and somewhat different form of protection and management, even though they do, in many instances, adjoin national forests and form contiguous parts of natural units of tree growth; but when the Indian equities are liquidated and the status of the reservations is changed the unallotted timberlands now comprising parts of such reservations should most emphatically be conserved and protected in the public interest by inclusion within national forests.

The amount available for purchases of lands under the Weeks law was the lowest of any year since the passage of the act; consequently the acreage approved for purchase fell markedly below the levels of previous years. This was unfortunate, as many desirable properties within the boundaries of existing purchase units were available for acquisition at low prices; and if larger expenditures had been authorized, the Government's holdings in the East could have been materially and advantageously increased. The purchase agreements approved by the National Forest Reservation Commission covered

79,923 acres; the total approved price was $347,767.98, and the average price per acre $4.35. This average, while $1.05 above that of the preceding year, is below the average of the total purchases to date and is a low value for the desirable properties involved.

While the approved purchases reflected the current progress of the work, the actual acquisition of land is not accomplished until transfers of title to the Government have been perfected. The lands actually acquired during the year aggregated 142,953.43 acres and cost $652,119.88, or an average of $4.56 per acre. By States they were distributed as shown in the following table:

*Acreage of timberland acquired in fiscal year 1923 and total acquired to July 1, 1923, by States.*

| State. | Acreage acquired in fiscal year 1923. | Average cost per acre. | Total acreage acquired to July 1, 1923. |
|---|---|---|---|
| Alabama | 15,568.01 | $4.91 | 79,449.20 |
| Arkansas | 12,367.37 | 3.10 | 53,206.02 |
| Georgia | 3,495.10 | 6.17 | 153,458.08 |
| Maine | 91.53 | 6.00 | 32,255.98 |
| New Hampshire | 719.73 | 6.69 | 405,068.41 |
| Nort hCarolina | 17,656.79 | 6.97 | 348,319.96 |
| South Carolina | 104.15 | 5.25 | 18,558.41 |
| Tennessee | 959.04 | 4.72 | 241,209.79 |
| Virginia | 62,338.54 | 4.85 | 431,511.82 |
| West Virginia | 29,653.17 | 2.68 | 132,108.78 |
| Total | 142,953.43 | 4.56 | 1,895,146.45 |

The total cost of all lands acquired has been $10,018,111.38, and the average cost per acre $5.29.

No new purchase units were established during the year, nor were any material changes made in the boundaries of existing units except the Allegheny, in northwestern Pennsylvania, where, with the consent and approval of the State, they were enlarged to embrace an additional 315,000 acres, partly rough slopes adjacent to the Allegheny and Clarion Rivers and partly lands contiguous to the New York State boundary and the Allegheny State Park.

For several years the National Forest Reservation Commission has recognized the need for larger appropriations for purchases to permit a faster consolidation of existing units and also extension of the work into new regions where Federal participation in forest regeneration is most desirable. Of the latter, a number were enumerated in the reports for the two preceding years. The most imperative need for the early establishment of new purchase units is (1) on mountainous watersheds in the Eastern States tributary to our great river systems, and (2) in the pineries both of the Southern and of the Lake States, where stream protection would be combined with the meeting of peculiarly urgent public requirements for the inauguration of measures to restore the forest on extensive areas of denuded and idle land. Public acquisition and reforestation of portions of these pine lands is important, not merely to bring about the reclamation to timber growth of the areas actually taken over, but also to provide practical demonstrations of what can be done in the solution of what are already large regional problems, of national importance and of growing magnitude.

To provide for increased acquisitions, the commission has consistently recommended annual appropriations of $2,000,000, or, in other words, a return to the scale of expenditures established by the Weeks law itself for the first 5 years of its operation. There can be no question of the soundness of such recommendations. The situation requiring constructive action by the Government is growing so rapidly in magnitude and public importance that measures adequate ten years ago now fall far short of the minimum public requirements. Delay will mean an aggravation of the rapid decline in the productive capacity of lands essential for timber production, yet with a probable advance in the prices which must be paid.

In the matter of land exchange, made possible by the passage of the general exchange act of March 20, 1922, and of other more specific measures, the year has been a period of study on the part of both the Forest Service and the owners of the lands subject to the operation of the exchange acts. The Forest Service did not deem it to the public interest to enter upon an extended program of exchanges until the relationship of the private lands to the national forest properties had been fully developed by careful study and sound plans formulated, or, more important still, until bases of valuation capable of economic justification had been evolved. The trend of land values, particularly of the types under consideration, obviously was variable and uncertain, and safety of appraisal lay only in thorough study of the trend in each locality. It has been difficult to reach agreements as to the worth of a number of acceptable properties, and only a few minor exchanges were consummated. The Forest Service, however, enters the new fiscal year with adequate exchange plans for every national forest and with voluminous data bearing on valuations. As the fiscal year came to an end there was increasing evidence that the values placed by many owners on private lands within the forests were gradually coming into harmony with those of the Forest Service, so that while the year ended without much to show in land actually acquired, an adequate and stable foundation was prepared for a program of exchanges based on conservative values.

The outstanding development in the classification of the national forests under the act of August 10, 1912, was the completion of the extensive classification of the Tongass Forest in Alaska. The intensive examination and classification of approximately 200,000 acres in that forest and the extensive and intensive classification of the Chugach Forest, also in Alaska, will complete this work. In the continental United States a few minor errors of classification were discovered and corrected, but appeals from the classification have dropped to a negligible number, and it now seems strikingly apparent that the classification commands full public confidence and is generally accepted as correct and dependable.

Practically all claims initiated prior to the creation of the national forests and almost all the claims initiated under the act of June 11, 1906, have now been adjusted, so that the claims work has dropped to a position of unimportance. The exploitation of mineral resources within the forests continues unabated, but largely under leases or licenses which offer no complicated questions of title or administration.

## FOREST PROTECTION.

### PROTECTION OF THE NATIONAL FORESTS.

Fires on the national forests in the calendar year 1922 compared in number, size, and causes with those of the two previous years as shown below. In the classification of causes for the 1922 statistics, the fires of unknown causes were thrown under the designation "Miscellaneous," and the old designation of "Campers," under which had been included all fires due to picnickers, fishermen, and other transients, gave away to the more restricted "Camp fires," while a new class was created through provision for recording separately fires traceable to smoking. In comparing the figures for the three years, allowance must be made for these changes.

*Comparison of fires on national forests, calendar years 1920, 1921, and 1922.*

| Classes and causes of fires. | Number of fires. | | | Percentage of total. | | |
|---|---|---|---|---|---|---|
| | 1920 | 1921 | 1922 | 1920 | 1921 | 1922 |
| Class of fire: | | | | | | |
| Burns less than 0.25 acre | 3,122 | 2,947 | 3,069 | 51.37 | 50.37 | 48.14 |
| Burns between 0.25 and 10 acres | 1,724 | 1,606 | 1,840 | 28.36 | 27.45 | 28.86 |
| Burns 10 acres and over | 1,232 | 1,298 | 1,466 | 20.27 | 22.18 | 23.00 |
| Total | 6,078 | 5,851 | 6,375 | 100.00 | 100.00 | 100.00 |
| Causes of fires: | | | | | | |
| Railroads | 508 | 643 | 381 | 8.36 | 10.99 | 5.98 |
| Lightning | 3,082 | 1,451 | 2,323 | 50.71 | 24.80 | 36.44 |
| Incendiarism | 245 | 562 | 870 | 4.03 | 9.60 | 13.65 |
| Brush burning | 248 | 365 | 236 | 4.08 | 6.24 | 3.70 |
| Campers [1] | 1,052 | 1,738 | ..... | 17.31 | 29.70 | ..... |
| Camp fires [2] | ..... | ..... | 843 | ..... | ..... | 13.22 |
| Smokers [2] | ..... | ..... | 1,110 | ..... | ..... | 17.41 |
| Lumbering | 211 | 156 | 156 | 3.47 | 2.67 | 2.45 |
| Unknown [1] | 485 | 674 | ..... | 7.98 | 11.52 | ..... |
| Miscellaneous | 247 | 262 | 456 | 4.06 | 4.48 | 7.15 |
| Total | 6,078 | 5,851 | 6,375 | 100.00 | 100.00 | 100.00 |

[1] Classification discontinued calendar year 1922.
[2] New classifications beginning calendar year 1922.

| Calendar year. | Total area of national forest land burned over. | Total damage on national forest land burned over. | Total cost of fighting fires exclusive of time of forest officers. |
|---|---|---|---|
| | *Acres.* | | |
| 1920 | 342,193 | $419,897 | $852,338 |
| 1921 | 376,208 | 212,182 | 456,099 |
| 1922 | 373,214 | 494,965 | 607,200 |

The 1922 fire season was marked by unusual weather conditions. Fires occurred early in June in most of the districts, and a severe fire season seemed in prospect, but rains and cooler weather in late July and early August afforded a respite. The situation then became critical again. No precipitation of any consequence occurred during September and most of October—a very unusual prolongation of the danger season. In district 4 (Utah, Nevada, southern Idaho, and southwest Wyoming) the heaviest expenditures for fire fighting were in late September and early October. In district 5 (Califor-

nia), however, the peak of the fire season was reached in the last 20 days in September.

In spite of the prolonged dry period, districts 1 and 2, located in the Rocky Mountain region, had the most favorable season in years. On the Pacific coast and in the Southwestern and Eastern States the situation was more difficult than usual. In district 6 (Oregon and Washington) the protective organization was seriously handicapped by the smoke blanket which covered the entire country during the season.

Man-caused fires dropped from 4,400 in 1921 to 4,052. In comparison with the averages for the five-year period 1916–1920, the percentages of fires caused by brush burning, railroads, and lumbering fell, while those caused by campers, smokers, and incendiaries rose. The incendiary fires were chiefly on one or two forests in district 1 and district 7, where some of the settlers are antagonistic to fire control. In most of the districts incendiary fires were fewer. The rapidly growing use of the national forests would naturally lead to many more campers' and smokers' fires; but the outstanding fact is that except for highly localized "sore spots" of incendiarism man-caused fires seem to be decreasing. They are undoubtedly decreasing rapidly in relation to the greater use of the forests for recreational purposes.

The area burned in 1922 was slightly less than in 1921, but the damage to national forest resources more than doubled. This was because of more serious fires in stands of merchantable timber in 1922. The cost of suppressing fires in 1922 amounted to $674,612, as compared to $512,106 in 1921 and $911,476 in 1920.

The 1923 fire season is not yet over, so that statistics covering it can not be given. During the months of May and June the fire situation was extremely critical on the Minnesota forests of district 2 and in district 7. The latter district is experiencing the worst fire season in its history. Most of the fires in Minnesota during May and June in 1923 occurred through the spreading of fires set by settlers and lumbermen in disposing of slash. The months of July and August were extremely favorable, and the indications are now that the season of 1923 for the Forest Service as a whole will be the best since 1916.

Fires which originated on lands outside of the forests were about average in number, but were more than usually extensive and destructive. The hazard created by fires which start in slashings on private lands is always present. Serious losses in property damage and fire-fighting expenditures occurred from this cause in Montana, Arizona, and New Mexico in 1922 and in Minnesota in the spring of 1923. This situation can be met only through cooperation with the operators on private holdings to extend to these outside lands the most effective standards of fire prevention. This cooperation is carried into effect where it has been brought to its highest development by means of a "cooperative fund," in which are set up the deposits made by the cooperating owners. Deposits to the credit of these cooperative funds aggregated $128,240.89 during the year.

In this financial cooperation it is planned that the cooperator's expenditures per acre shall not be less than those of the Forest

Service in the region. Large landowners pay their pro rata share of the actual cost of protection and suppression; for small owners the agreements provide for flat rates per acre, based upon average protection and suppression costs over a term of years. The drive that has been made for cooperation on the part of owners, as well as of municipalities, water users, and others owning no lands but having hardly less concrete interests at stake, has brought good response. The interest of residents and settlers is secured through personal contact by the rangers and other forest officers, supplemented by hammering home upon them by all available means of publicity the vital necessity of guarding against fire and operating quickly by concerted action when fires occur.

Frequently the Forest Service has had to expend funds from its appropriation for fire protection, although the burden should have been borne by others. It is obvious that in such a case there must be a definite placing of responsibility and that effort must be directed toward enlisting the active assistance of settlers, users of the forest resources, and others interested in the detection and suppression of forest fires. Responsibility for preventing and suppressing fires must be placed squarely upon all agencies which, because of their operations, create fires, and pressure, either by negotiation or by legal process, must be brought upon such agencies for the collection of fire costs and damages for which they are responsible. Cases of fire trespass, in which evidence justifying legal action can be adduced, are taken into court by the Department of Justice if a satisfactory settlement can not be reached in any other way. As the result of a vigorous policy in this direction a secondary line of cooperation is being built up, namely, an acceptance of Forest Service standards of fire prevention and suppression and the application of these standards by the outside agencies themselves as a measure of self-interest.

Important progress has been made in methods of fire control. The problems involved have been attacked at their roots. Successful fire control is not merely a matter of a quick, decisive fight against roaring flames. Such contests between man and the destructive forces of nature are merely incidents in a maze of matters which go to make up the whole of systematic fire control. Years of search have failed to disclose any simple or easy road to mastery of the problem of fire control in American forestry. Merely spending more money for guards and equipment, important as these are, is futile unless the most careful attention is given to a multitude of details involved in the management of the men, money, and equipment required for the work.

Control of summer fires begins the preceding fall, when a scattered forest personnel must analyze the results of the fire season then closing and by study and exchange of ideas learn the lessons the closing season has taught. During each winter detailed plans must be made covering the procurement, conditioning, and placing of tools and equipment for use during the coming season; plans for reaching the general public with talks and printed matter dealing with care with fire must be reviewed and revised; arrangements must be planned which will secure financial cooperation from private owners of land lying in or adjacent to the national forests and the personal effort of residents within or near the forest boundary

who may be needed when the fire danger comes the following summer; financial and organization plans must be made which will control the number of fireguards employed for each unit and determine just where each man is to be stationed. All the work covered by these plans which can possibly be done during the winter must be completed in order to lessen by that much the rush which begins with the opening of spring work.

During the spring months telephone lines and pasture fences must be repaired, tools and equipment placed at points throughout the forest which are likely to be most convenient when fires occur, guards hired in advance for the season's work, training camps for the guards arranged for and held, and final arrangements with cooperators worked out. Then comes the giving of final instructions to guards and their placement on lookout peaks and at guard stations. What happens after that, when careless users of the forest start fires or lightning sows destruction, is not so much a struggle between fire fighters and the flames as it is a test of the thoroughness and adequacy of the thinking and preparatory work which have gone on during the preceding months.

As has been indicated in previous reports, the wide variety of physical and human conditions encountered on the national forests, together with the scattered location of forest officers, positively precludes the formulation of uniform detailed plans and instructions by any central agency, no matter how expert it may be. Advance planning by the individual district ranger and forest supervisor is indispensable to successful fire control in each ranger district and national forest.

Viewing fire control in this light, a steady but extremely important development is occurring along two lines. First, there is gratifying activity on the part of the body of men concerned in the recognition of significant fire facts and in acting upon them. This promises well for early completion of the pioneer work. The most important need at present is to bring forest officers together regularly in training camps for group discussion of the knowledge and experience gained by each and for instruction by specialists in various branches of fire control. Secondly, a heightened sense of personal responsibility is to be found among forest officers. The most effective means of promoting it is by inspection by trained men which weighs the results obtained and fixes responsibility for both the good and bad work discovered.

Four years of experience with aerial forest-fire patrol has established that regular daily patrol by planes does not yield sufficient results to justify the cost. A given spot in the forest is under observation for only 15 to 30 minutes of each patrol. A fire which shows up just after the air patrol has passed must go unobserved and unreported, so far as aerial detection is concerned, until the next patrol, which may be the next day. The main dependence for the detection of fires must be placed on lookout men stationed on mountain peaks and towers. Nevertheless, planes have an important place in fire control. Planes and pilots should be placed a few hundred miles apart throughout California and the Northwestern States. When fires get large a reconnaissance from the air is a very useful method of securing vital information; smoldering fires started by lightning should be searched out by planes after bad electrical

storms; systematic air patrol may be very important for a few weeks at a time when a smoke blanket renders fire detection from stationary lookouts on mountain peaks ineffective. From selected points an average of from 25 to 50 flights yearly would be an important adjunct to the other available means of controlling fire on the national forests.

It is therefore highly desirable that some way be found, if possible, to resume the cooperation with the Air Service of the Army under which aerial patrol was formerly maintained in parts of the West. This, however, must probably await the time when the fiscal situation of the Government admits of special provision for meeting the expenses involved.

In the expenditure of the improvement appropriation in recent years pronounced preference has been given to protection facilities. By sacrificing other improvements less urgently needed, the telephone system so important to fire control has been brought up to a total of 28,896 miles, leaving only 8,599 miles of additional line needed to provide a reasonably adequate communication system for fire purposes. With the regular improvement appropriation this can be cared for fairly well, although the necessity for repair and reconstruction is creating a growing burden.

But little headway has been made, however, in the construction of fire-lookout houses. No form of administrative control will keep a man as continuously at his post as he should be if, while on his peak searching for smoke, he is exposed to the wind and chill of a high elevation or if his shelter on the peak is so small that he has to do his cooking and sleeping at a cabin some distance below. Years of experience have evolved a standard type of lookout house which enables lookouts to serve effectively as the eyes of the fire organization. One hundred and ninety-four such houses are now in use, but 224 are still needed for primary lookouts.

### PROTECTION OF PUBLIC FORESTS FROM INSECTS.

The extent to which valuable timber may be killed by forest insects and the feasibility of preventing enormous losses through the application of proper control measures have both been thoroughly demonstrated in the large insect-control project in southern Oregon and northern California mentioned in last year's report. The work on this project is now about two-thirds completed. It has been conducted, under the leadership of the Bureau of Entomology, as a cooperative project between the various bureaus of the Federal Government having jurisdiction over Government owned or controlled lands in the region, the State of Oregon, and the owners of private lands. The work so far done has saved timber to a value of many times the expenditure for protection. Personal inspection of the work convinced me that it had been conducted efficiently and economically, with a fair distribution of the cost between the various owners of the property protected. The Government's share was financed out of a special appropriation, the unexpended balance of which should be reappropriated in order to finish the task.

Insects menace both publicly owned and privately owned timber throughout the country, and heavy losses of stumpage are not infrequent. The danger is especially acute in practically all of the

pine forests of the West within which many of the national forests are situated. In these pine forests an insect attack seldom destroys the possibility of further growth on the land as does fire, but the aggregate loss of commercially valuable timber is enormous, since the oldest and therefore the largest and more valuable trees are chiefly affected. The public forests urgently need an adequate and systematic organization for protection from insect losses along lines similar to those now followed in fire protection; and as in the case of fire protection, this organization must be able to cooperate effectively with the owners of intermingled or adjacent timberland within the threatened area.

The immediate requirements, particularly for the pine forests in the West, are adequate provision for research by the Bureau of Entomology looking to the development of the technique of control methods, and a fund which the Secretary of Agriculture may expend in protecting publicly owned or controlled timber, of whatever status, as emergencies require. At the present time serious losses from tree-destroying insects are occurring or are threatened particularly in certain of the pine forests in California, in Oregon, in northern and central Idaho, in central Montana, and in northern Arizona.

### PROTECTION OF PUBLIC FORESTS FROM TREE DISEASES.

The need for adequate means of meeting dangers to our forests from tree diseases is brought home forcibly by the discovery, made by the Bureau of Plant Industry, that the white-pine blister rust is established in the forests of British Columbia and on its alternate host (the genus *Ribes*) in the State of Washington. This discovery marks the beginning of a serious economic problem. The presence of this imported disease is a danger not only to many millions of dollars' worth of merchantable western white-pine timber, both public and private, but also to the future crops of these trees, which are the most valuable of the important commercial trees in their respective regions. Other kinds of trees may keep the land productive, but these five-needled pines will bring the largest returns, and inability to grow them would be an economic disaster to the regions concerned and to the nation-wide users of lumber. It is good public economy and an elemental business precaution to prevent losses from this disease in the existing merchantable timber on the national forests and to protect the young stands from which the future crops of the same timber must come, just as losses from fire are guarded against.

The white-pine blister rust is an undesirable alien from Europe, where it prevents the growing of species of white pine over large areas. In its life cycle it alternates between the five-needled pines and currant or gooseberry bushes in the same way that wheat rust alternates between barberry and wheat plants. The Bureau of Plant Industry has demonstrated that in the case of this disease, as with others which have alternate plant hosts, protection is possible by the removal of one of the hosts, and in the case of this disease the eradication of all currant or gooseberry bushes within or near stands of

white pine is the necessary step. Wild currants and gooseberries are so widely distributed within and near the western forests, however, that while the progress of the disease may be delayed by quarantines and similar measures its ultimate spread throughout the white-pine-producing regions of the West seems certain, and the local control of the disease is necessary, just as the prevention of loss from forest fires is a matter of organization for the protection of specific areas.

The danger from this disease is recognized by many of the private owners of white-pine timber and by the agencies which administer publicly owned forests. A blister-rust advisory board, representing both public and private interests, has been formed in the West and has recommended prompt and vigorous action by the Nation, the States, and the private owners. There is urgent need for aggressive Federal leadership in meeting the menace of this disease in the western forests through the continuation of studies to develop practical means of combating the disease and by the active protection of the endangered Government property.

### PROTECTION OF STATE AND PRIVATE FORESTS.

No new States established forest-fire protective systems during the year, but the effectiveness of the work markedly increased. Appropriations by the States for protection against forest fires, although still far from adequate, resulted in both an extension of the protected areas and a betterment of the lookout stations, trails, and similar improvements. Of all the States having important forest resources to protect, those in the Southeast, from South Carolina to Mississippi and Arkansas, inclusive, are the only ones yet remaining to take action against forest fires. This section is still a large center of lumber production and has in consequence not felt the pinch from dwindling timber supplies, and further, the southern forests are not susceptible to the kind of fires which destroy whole stands of timber and cause spectacular losses. However, there is none the less a need for protection, especially of the cut-over and young-growth lands, in order that new forests may come on and help supply future needs after the passing of the virgin stands. In the Pacific Northwest, where most of the merchantable timber is given systematic protection, the cut-over and regrowing lands are in some instances receiving relatively meager protection or none at all. There is just as urgent need for the protection of these cut-over and regrowing lands in the West as there is in the South.

The Federal appropriation for protecting from fire, in cooperation with States, the forested watersheds of navigable streams was the same as in the previous year—$400,000. The increase over the $125,000 received in 1921 induced some States to increase their protective budgets in order to receive larger Federal allotments during the past year. In consequence it was necessary to reduce the maximum allotment to any State from $25,000 to $24,000. The inadequacy of the present Federal cooperation grows more and more evident. As in previous years, special allotments from a contingent fund reserved for emergencies were made to the States which experienced severe fire conditions, compelling them to exceed their budgets of estimated expense. Such allotments amounted all told

to $11,300, and were made to Maine, Connecticut, New York, New Jersey, Maryland, Virginia, West Virginia, North Carolina, Louisiana, and Idaho.

The total allotments to the States, including emergency allotments, were as follows:

*Cooperative expenditures in fire protection under the Weeks law, fiscal year 1923.*

| State. | Federal. | State. | Total. |
|---|---|---|---|
| Maine | $25,183.82 | $136,181.56 | $161,365.38 |
| New Hampshire | 6,705.52 | 31,178.85 | 37,884.37 |
| Vermont | 4,200.00 | 9,007.55 | 13,207.55 |
| Massachusetts | 8,399.82 | 80,522.42 | 88,922.24 |
| Rhode Island | 455.77 | 7,984.31 | 8,440.08 |
| Connecticut | 4,025.00 | 23,577.78 | 27,602.78 |
| New York | 24,368.26 | 162,706.28 | 187,074.54 |
| New Jersey | 5,775.00 | 54,742.86 | 60,517.86 |
| Pennsylvania | 24,000.00 | 488,783.50 | 512,783.50 |
| Maryland | 4,050.00 | 11,652.04 | 15,702.04 |
| Virginia | 17,663.40 | 17,663.41 | 35,326.81 |
| West Virginia | 10,500.00 | 20,036.82 | 30,536.82 |
| North Carolina | 12,306.88 | 14,272.96 | 26,579.84 |
| Tennessee | 9,981.01 | 9,981.01 | 19,962.02 |
| Louisiana | 21,750.00 | 43,668.49 | 65,418.49 |
| Texas | 14,000.00 | 14,047.43 | 28,047.43 |
| Ohio | 1,050.00 | 9,144.25 | 10,194.25 |
| Michigan | 22,285.92 | 138,502.03 | 160,787.95 |
| Wisconsin | 13,879.97 | 19,161.51 | 33,041.48 |
| Minnesota | 24,000.00 | 244,752.13 | 268,752.13 |
| South Dakota | 100.00 | 5,445.00 | 5,545.00 |
| Montana | 13,722.08 | 16,373.31 | 30,095.39 |
| Idaho | 29,037.58 | 93,584.71 | 122,622.29 |
| Washington | 24,000.00 | 78,626.93 | 102,626.93 |
| Oregon | 24,000.00 | 42,920.62 | 66,920.62 |
| California | 22,248.32 | 51,912.89 | 74,161.21 |
| Administration and inspection | 27,522.80 | ..... | 27,522.80 |
| Total | 395,211.15 | 1,826,430.65 | 2,221,641.80 |

Unexpended balance, $4,788.85.
Appropriation, $400,000.

With protection against forest fires in the formative stage or entirely absent throughout a portion of the country, complete figures on the losses sustained are impossible to secure. Nevertheless, through the assistance of States where protective systems are established and of interested cooperators in other States, the Forest Service has been securing reports on forest-fire losses during the past seven years. These reports indicate an average for this period of 36,100 fires annually, with 7,244,000 acres of forest land burned over and immediate property losses of $16,463,000. The causes of fire were: Campers and smokers, 15.5 per cent; railroads, 14.6; incendiarism, 14.1; brush burning, 13.5; lightning, 8.7; lumbering, 5.7; miscellaneous, 6.6; and unknown, 21.3. The estimated number of fires in 1922 was 51,900, or 44 per cent more than the average, but they burned over only 13 per cent more forest land and the property loss showed practically no increase.

The indicated number of fires in 1922, with the damage caused and the forest land burned over, was as shown below. On account of the varying character and completeness of the data on the basis of which the totals are computed, however, regional comparisons involve elements of uncertainty.

*Summary of forest fire statistics, by groups of States, for the United States (exclusive of Alaska), 1922.*

| Group of States.[1] | Number of fires. | | Damage. | | Forest land burned. | |
|---|---|---|---|---|---|---|
| | Total. | Per cent. | Total. | Per cent. | Total. | Per cent. |
| | | | | | *Acres.* | |
| United States (exclusive of Alaska) | 51,891 | 100 | $16,678,485 | 100 | 8,194,189 | 100 |
| Northeastern group | 8,054 | 15.5 | 1,865,659 | 11.2 | 298,315 | 3.6 |
| Appalachian group | 5,749 | 11.1 | 1,534,825 | 9.2 | 693,629 | 8.5 |
| Southeastern group | 15,935 | 30.7 | 5,727,469 | 34.3 | 4,515,061 | 55.1 |
| East Mississippi group | 1,467 | 2.8 | 467,890 | 2.8 | 210,724 | 2.6 |
| West Mississippi group | 9,337 | 18.0 | 1,956,707 | 11.7 | 1,377,502 | 16.8 |
| Lake States group | 2,019 | 3.9 | 1,199,459 | 7.2 | 333,228 | 4.1 |
| Rocky Mountain group | 3,601 | 6.9 | 844,925 | 5.1 | 152,061 | 1.8 |
| Pacific group | 5,729 | 11.1 | 3,081,551 | 18.5 | 613,669 | 7.5 |

[1] Northeastern group: New England States, New York, and New Jersey.
Appalachian group: Pennsylvania, Delaware, Maryland, Virginia, and West Virginia.
Southeastern group: North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.
East Mississippi group: Ohio, Indiana, Illinois, Kentucky, and Tennessee.
West Mississippi group: Missouri, Arkansas, Oklahoma, Louisiana, and Texas.
Lake States group: Michigan, Wisconsin, and Minnesota.
Rocky Mountain group: Montana, Idaho, Wyoming, South Dakota, Colorado, Arizona, New Mexico, Nevada, and Utah.
Pacific group: Washington, Oregon, and California.

In addition to the direct loss which can be measured in dollars and cents, as given in the preceding table, there is an enormous loss of an indirect and intangible nature from the subsequent decay of fire-damaged timber, destruction of young tree growth, soil deterioration, erosion interfering with navigability of streams and the development of water power, damage from floods, destruction of wild life, impairment of recreational values, and similar consequences.

The total expenditure for protecting forest lands outside of Federal holdings is approximately $3,300,000 a year, of which States pay $1,900,000, private owners $1,000,000, and the Federal Government $400,000. The expenditures by private owners of forest land often materially exceed the amount indicated in years of special danger. About 40 per cent of the total expenditure is in the Northeast, 20 per cent in the Lake States, 30 per cent in the far West, and 10 per cent in the South. All told, the amount is a little more than one-third that necessary for adequate protection. Since it is expended on approximately one half of our State and private forest lands, in many instances they receive but partial protection, while the other half receives no organized protection whatever. Without the complete and adequate protection of privately owned forest lands there can be no hope for the production of a continuous yield of timber. Even where economic conditions make it practicable for private owners to grow timber crops, they are often hesitating because of the fire hazard and particularly the menace of fire from adjoining lands. Unless private owners can be assured of reasonably adequate protection they can scarcely be expected to keep their cut-over lands in a condition of productiveness. The private forest owner should be given a chance.

Like other big national undertakings, such as road improvement and agricultural extension, the protection of our forests can best be

given an impetus through the aid of the Federal Government. A general formula for the cost of protecting private forest lands which has been widely accepted is that the owners and the public should share it alike and that the share of the public, as represented by the Federal Government, should be approximately one-fourth. On this basis, if the yearly expenditure required to protect private forest lands in the United States is $9,263,000, as is estimated, the share of the Federal Government would be about $2,300,000 yearly, or nearly six times the present appropriation for this purpose.

## NATIONAL FOREST MANAGEMENT.

### TIMBER.

More timber was cut from the national forests during the past year than ever before in their history, and the receipts from sales were greater. The timber business of the year compared with that of 1922 is as follows:

*Totals of timber sold, timber cut, and receipts from sales.*

| Fiscal year. | Timber sold (board feet). | Timber cut (board feet). | Receipts from sales of timber. |
|---|---|---|---|
| 1923 | 2,288,585,000 | 991,982,000 | [1] $2,641,244.08 |
| 1922 | 2,129,364,000 | 728,531,000 | 1,780,347.24 |
| Increase | 159,221,000 | 263,451,000 | 860,896.84 |

[1] The figures given on p. 10 include receipts for timber cut in trespass.

There has been on the whole a steady rise in the amount of timber cut and sold annually from the national forests since their creation. The sharp increase in the business last year is more than a temporary peak; it is the result of clearly defined economic forces that have been at work for several years and point to a continuing increase during the next decade.

Perhaps the greatest factor affecting the growth of the timber-sale business in the national forests is the continued activity in lumber production stimulated by the favorable market of the last two years. Throughout the United States and during practically the entire year urban and industrial construction has gone forward steadily.

The export lumber business has not fully recovered from the effects of the war, but well-informed men in the industry believe that the volume of lumber required for domestic use and the export trade combined will not recede from its present level.

Another prime factor affecting the volume of timber business in the national forests, as pointed out in last year's report, is the continued western migration of forest industries from the depleted regions of the East. Eastern sawmill capital is at present being invested more largely on the Pacific coast than elsewhere. This is reflected in the timber sales in the national forests of that region. In

California the increase in the timber-sales business of 1923 over 1922 was 145 per cent, and in Oregon and Washington it was 31 per cent. The increase in Alaska was 73 per cent, but this was largely to supply the needs of the Alaskan fisheries and other local industries.

As a usual thing national forest timber is more remote and less accessible than the privately owned timber, most of which was acquired before the creation of the forests. As a consequence, new capital is usually invested in private stumpage in preference to seeking that owned by the Government. The greatest call upon national forest resources will come when the bulk of the privately owned timber has been acquired by operating companies. The increase in the sales of stumpage on the national forests during the last year indicates that a considerable portion of the rampart of privately owned timberlands that stands between the national forests and the main-line transportation systems has been so acquired and that the sawmill capital yet to go West will tend more largely to seek national forest stumpage.

Among the outstanding timber sales of the year was the Bear Valley unit, on the Malheur Forest, in Oregon. It involves 890,000,000 board feet of timber, chiefly western yellow pine. This timber will bring into the Treasury not less than $2,250,000 in the 20 years of the sale. The management plan under which the sale was made contemplates a continuous supply of from 40,000,000 to 60,000,000 feet annually to one manufacturing center. The capital invested in this sale originated in the Lake States in the days of white pine and has moved south and west periodically since. So far as a supply of raw material is concerned, it will never have to move again.

Another sale of interest, not because of the large amount of timber or its bearing upon agricultural development in the surrounding region, but on account of the values involved, is that on the Burnt Cabin Creek unit, in the Coeur d'Alene Forest, Idaho. This sale covers approximately 3,360 acres on the Little North Fork of the Coeur d'Alene River, and involves the cutting of 70,000,000 feet of western white pine, white fir, Engelmann spruce, Douglas fir, larch, and hemlock, with white pine forming about 80 per cent of the stand. The successful bidder was awarded this timber at a price that will total $630,175. This averages a little better than $9 per thousand board feet, which marks a new level of values for western timber. The stumpage price of the white pine alone is $11.40 per thousand feet. A feature of the sale is that the purchasers agreed to acquire rights of way where the 10 miles of railroad within the forest crosses private land and to turn these over to the Government at the end of the operation. This will assure the Government an outlet by rail for the large amount of timber that remains on the Coeur d'Alene River.

Within two decades the bodies of merchantable timber in most of the national forests will be in demand by the lumber and paper industries. To utilize the present stands to best advantage, to cut them so as to assure a new crop of high quality, and to manage the whole development so that the principle of a sustained yield will not be endangered, necessitates technical skill and intensive forestry

practice, and the time when they will be needed is not 20 years away, but immediately. As shown by this year's jump in the volume of business, the demand for national forest timber is coming in a rush, and the service must be prepared to meet it with plans, methods, and trained men.

To take care of the growing volume of sales will require more and more preliminary timber surveys and management plans. Sales must be based on careful examinations covering large areas, so that mature and deteriorating timber may be cut at the earliest practicable time, the national properties developed in the most business-like way, and the cream of the timber, which is most desired by operators, not skimmed off without utilizing the less valuable species or less accessible portions of the stand. New operations can not be located where a perpetual supply of raw material will be assured without careful study of all economic and silvicultural factors, so as to keep the manufacturing capacity within the producing power of the soil. The application of sound technical methods to secure regrowth to the full timber-producing capacity of the soil will be necessary on a larger and larger area each year, and an increasing intensity of protection of the regenerating areas from fire, insects, and disease.

The current business is already taxing the service to the utmost. Less than 15 per cent of the 1,733 field men who are directly responsible for the cuttings on the national forests are trained foresters. Of the 143 supervisors who are in charge of the national forests only 60 are forest-school graduates, and of the deputy supervisors, only 8. To put into practice the sound technical methods that are essential to secure the results expected of the national-forest administration, there must be a material increase in the number of trained foresters.

To build up a sufficient corps of qualified and experienced sales officers, systematic training while in the service is also essential. In the past the volume of the sales work has not been so large and the demand of other lines of work has not been so great but that men could obtain the requisite training in the course of their employment. This condition no longer holds. To keep pace with current timber sales, the whole organization has been speeding up, and now there is neither time nor opportunity to train new men in the old way. Stations or camps for the training of timber-sales officers are entirely practicable, since the service has competent and experienced men available to impart the training required. This work should be gone at systematically through group training at instruction camps.

*Timber cut under sales, calendar year ended December 31, 1922.*

| State. | Board feet. | | | Value. | | |
|---|---|---|---|---|---|---|
| | Commercial sales. | Cost sales. | Total. | Commercial sales. | Cost sales. | Total. |
| Alabama | 12,000 | | 12,000 | $113 | | $113 |
| Alaska | 23,943,000 | | 23,943,000 | 41,400 | | 41,400 |
| Arizona | 55,243,000 | 616,000 | 55,859,000 | 127,174 | $525 | 127,699 |
| Arkansas | 6,735,000 | 195,000 | 6,930,000 | 31,987 | 201 | 32,188 |
| California | 214,494,000 | 2,111,000 | 216,605,000 | 661,870 | 1,265 | 663,135 |
| Colorado | 28,843,000 | 1,499,000 | 30,342,000 | 70,437 | 1,365 | 71,802 |
| Florida | 1,208,000 | | 1,208,000 | 4,860 | | 4,860 |
| Idaho | 90,294,000 | 4,197,000 | 94,491,000 | 314,343 | 3,983 | 318,326 |
| Michigan | 60,000 | | 60,000 | 174 | | 174 |
| Minnesota | 2,535,000 | | 2,535,000 | 12,461 | | 12,461 |
| Montana | 42,741,000 | 4,954,000 | 47,695,000 | 100,592 | 4,290 | 104,882 |
| Nevada | 1,685,000 | 259,000 | 1,944,000 | 1,912 | 225 | 2,137 |
| New Hampshire | 2,962,000 | | 2,962,000 | 18,001 | | 18,001 |
| New Mexico | 23,218,000 | 1,127,000 | 24,345,000 | 38,543 | 1,040 | 39,583 |
| North Carolina | 8,295,000 | | 8,295,000 | 23,308 | | 23,308 |
| Oregon | 168,209,000 | 2,844,000 | 171,053,000 | 394,890 | 1,711 | 396,601 |
| South Dakota | 18,343,000 | 838,000 | 19,181,000 | 54,118 | 767 | 54,885 |
| Tennessee | 6,235,000 | 86,000 | 6,321,000 | 14,268 | 86 | 14,354 |
| Utah | 7,604,000 | 900,000 | 8,504,000 | 17,125 | 908 | 18,033 |
| Virginia | 3,823,000 | 12,000 | 3,835,000 | 10,296 | 11 | 10,307 |
| Washington | 104,694,000 | 516,000 | 105,210,000 | 180,654 | 309 | 180,963 |
| West Virginia | 22,000 | | 22,000 | 77 | | 77 |
| Wyoming | 44,949,000 | 672,000 | 45,621,000 | 99,560 | 647 | 100,207 |
| Total, 1922 | 856,147,000 | 20,826,000 | 876,973,000 | 2,218,163 | 17,333 | [1] 2,235,496 |
| Total, 1921 | 666,191,000 | 21,731,000 | 687,922,000 | 1,646,817 | 16,363 | [2] 1,663,180 |

[1] In addition, minor products not convertible into board feet were cut, value, $8,096.
[2] In addition, minor products not convertible into board feet were cut, value, $4,511.

*Timber sold, calendar year ended December 31, 1922.*

| State. | Board feet. | | | Value. | | |
|---|---|---|---|---|---|---|
| | Commercial sales. | Cost sales. | Total. | Commercial sales. | Cost sales. | Total. |
| Alabama | 110,000 | | 110,000 | $196 | | $196 |
| Alaska | 22,533,000 | | 22,533,000 | 36,401 | | 36,401 |
| Arizona | 23,248,000 | 504,000 | 23,752,000 | 53,851 | $490 | 54,341 |
| Arkansas | 5,838,000 | 198,000 | 6,036,000 | 27,216 | 194 | 27,410 |
| California | 1,107,636,000 | 2,045,000 | 1,109,681,000 | 3,638,027 | 1,368 | 3,639,390 |
| Colorado | 29,094,000 | 1,082,000 | 30,176,000 | 75,971 | 1,101 | 77,072 |
| Florida | 846,000 | | 846,000 | 3,055 | | 3,055 |
| Idaho | 65,270,000 | 5,010,000 | 70,280,000 | 246,907 | 4,789 | 251,696 |
| Michigan | 60,000 | | 60,000 | 174 | | 174 |
| Minnesota | 288,000 | | 288,000 | 1,909 | | 1,909 |
| Montana | 36,231,000 | 4,182,000 | 40,413,000 | 93,677 | 4,036 | 97,713 |
| Nevada | 1,594,000 | 150,000 | 1,744,000 | 1,814 | 141 | 1,955 |
| New Hampshire | 1,349,000 | | 1,349,000 | 4,976 | | 4,976 |
| New Mexico | 12,840,000 | 1,234,000 | 14,074,000 | 35,695 | 1,121 | 36,816 |
| North Carolina | 6,256,000 | | 6,256,000 | 10,775 | | 10,775 |
| Oregon | 57,196,000 | 3,298,000 | 60,494,000 | 102,838 | 2,030 | 104,868 |
| South Dakota | 26,913,000 | 732,000 | 27,645,000 | 93,084 | 725 | 93,809 |
| Tennessee | 4,255,000 | 84,000 | 4,339,000 | 9,163 | 84 | 9,247 |
| Utah | 11,689,000 | 1,173,000 | 12,862,000 | 25,942 | 1,193 | 27,135 |
| Virginia | 6,500,000 | 22,000 | 6,522,000 | 17,143 | 22 | 17,165 |
| Washington | 366,318,000 | 761,000 | 367,079,000 | 624,453 | 470 | 624,923 |
| West Virginia | 131,000 | | 131,000 | 300 | | 300 |
| Wyoming | 70,874,000 | 920,000 | 71,794,000 | 203,206 | 950 | 204,156 |
| Total, 1922 | 1,857,069,000 | 21,395,000 | 1,878,464,000 | 5,306,773 | 18,709 | [1] 5,325,482 |
| Total, 1921 | 1,253,579,000 | 23,412,000 | 1,276,991,000 | 3,743,463 | 19,330 | [2] 3,762,793 |

[1] In addition, other products not convertible into board feet were sold, value $21,989.
[2] In addition, other products not convertible into board feet were sold, value $5,485.

*Number of timber sales, classified according to amount of sale, calendar year ended December 31, 1922.*

| State. | $100 or under. | | | $101 to $500. | $501 to $1,000. | $1,001 to $5,000. | Over $5,000 | Total. |
|---|---|---|---|---|---|---|---|---|
| | Commercial. | Cost. | Total. | | | | | |
| Alabama | 11 | | 11 | | | | | 11 |
| Alaska | 181 | | 181 | 3 | 1 | 8 | 2 | 195 |
| Arizona | 780 | 269 | 1,049 | 9 | 5 | | 3 | 1,066 |
| Arkansas | 40 | 75 | 115 | 2 | 2 | 2 | 2 | 123 |
| California | 509 | 359 | 868 | 20 | 4 | 17 | 11 | 920 |
| Colorado | 527 | 253 | 780 | 9 | 3 | 5 | 5 | 802 |
| Florida | 61 | | 61 | | | | | 61 |
| Idaho | 942 | 1,477 | 2,419 | 14 | 7 | 13 | 13 | 2,466 |
| Michigan | 6 | | 6 | | | | | 6 |
| Minnesota | 5 | | 5 | | | 1 | | 6 |
| Montana | 660 | 1,049 | 1,709 | 17 | 4 | 9 | 3 | 1,742 |
| Nebraska | 13 | | 13 | | | | | 13 |
| Nevada | 112 | 53 | 165 | | | | | 165 |
| New Hampshire | 118 | | 118 | | 1 | 2 | | 121 |
| New Mexico | 567 | 509 | 1,076 | 1 | 4 | 5 | 1 | 1,087 |
| North Carolina | 200 | | 200 | 3 | 2 | 2 | | 207 |
| Oklahoma | 25 | | 25 | | | | | 25 |
| Oregon | 318 | 581 | 899 | 6 | 4 | 4 | 8 | 921 |
| South Dakota | 319 | 134 | 453 | 7 | 3 | 9 | 5 | 477 |
| Tennessee | 147 | 39 | 186 | 1 | 1 | 3 | | 191 |
| Utah | 333 | 619 | 952 | 8 | 1 | 1 | 1 | 963 |
| Virginia | 336 | 11 | 347 | 1 | 6 | 2 | | 356 |
| Washington | 427 | 122 | 549 | 8 | 7 | 10 | 6 | 580 |
| West Virginia | 8 | | 8 | | | | | 8 |
| Wyoming | 228 | 176 | 404 | 3 | 1 | 2 | 4 | 414 |
| Total, 1922 | 6,873 | 5,726 | 12,599 | 112 | 56 | 95 | 64 | 12,926 |
| Total, 1921 | 6,820 | 6,621 | 13,441 | 93 | 43 | 82 | 26 | 13,690 |

## REFORESTATION.

The following tabulation shows the national forest area planted or sowed to commercial timber during the calendar year 1922, by States:

*Planting and sowing on national forests, by States, calendar year ended December 31, 1922.*

| State. | Area planted. | Area sown. | Total. |
|---|---|---|---|
| | *Acres.* | *Acres.* | *Acres.* |
| Minnesota | 1,772.13 | | 1,772.13 |
| Idaho | 1,301.30 | 20.00 | 1,321.30 |
| Washington | 1,309.00 | | 1,309.00 |
| Nebraska | 947.60 | | 947.60 |
| Colorado | 792.33 | | 792.33 |
| Michigan | 607.00 | | 607.00 |
| Montana | 286.00 | | 286.00 |
| West Virginia | 21.00 | | 21.00 |
| Oregon | 15.00 | | 15.00 |
| Florida | | 1.50 | 1.50 |
| South Dakota | .53 | | .53 |
| Total | 7,051.89 | 21.50 | 7,073.39 |

At the present rate of progress in planting it will take from 150 to 200 years to reforest the denuded areas in the national forests that can be restored to productivity in no other way. That our present

program of planting is grossly inadequate is evident, and the growing realization of the future shortage of timber supplies emphasizes the need for a more comprehensive planting program. As a first step in this direction the Forest Service is this year making a survey of the national forests with a view to submitting a plan for the reforestation of denuded areas within a reasonable period of time. Its execution, however, must await provision by Congress of increased funds.

## RANGE.

### GENERAL CONDITIONS.

Broadly speaking, the grazing season of 1922 was about normal. On more than 40 per cent of the national forests the rainfall was below average, but it came at a time to do the most good, and the feed, although not particularly heavy, produced fat cattle and sheep. The winter of 1922–23 was comparatively mild, with hay plentiful, and the spring of 1923 opened up sufficiently early to have green feed available at the usual time. The winter losses were therefore light, although as a rule both cattle and sheep were rather thin at the time of entering the national-forest ranges.

In the Southwest, however, especially in New Mexico and Arizona, the drought which has now lasted for practically three years was broken only in part, the precipitation being extremely spotted and the growth of vegetation light. This was especially true in southern New Mexico and Arizona, and sheepmen whose stock lambed early in 1923 suffered heavy losses, due to lack of green feed for the young stock. While beef cattle on nearly all ranges were in excellent condition in the fall of 1922, the average weights were at least 100 pounds below normal. To a large extent lambs placed on the market were also underweight.

Losses from all causes during the year were somewhat less than average. The work of the Biological Survey in eliminating predatory animals has undoubtedly caused a decrease in losses from that source, and the absence of heavy rainfall prevented a rank growth of poisonous plants, especially larkspur, which cut down the losses from this cause materially.

### USE OF THE RANGE.

The table below shows the number of stock grazed under permit and the number of permits issued for the calendar year 1922. The business was somewhat less than in previous years, primarily because of stock sales to reduce indebtedness, plus the inability of many stockmen to meet the grazing charges, which forced them to hold their stock on their own lands. However, the vacant ranges will not lie idle long, as other stockmen will apply for the next season.

*Grazing permits issued and number of stock grazed, calendar year ended December 31, 1922.*

| State. | Permits issued. | Number of stock. | | | Permits issued. | Number of stock. | |
|---|---|---|---|---|---|---|---|
| | | Cattle. | Horses. | Swine. | | Sheep. | Goats. |
| Alabama | 9 | 203 | | | | | |
| Arizona | 1,349 | 295,927 | 3,154 | 307 | 104 | 298,114 | 1,670 |
| Arkansas | 183 | 2,614 | 25 | 164 | 5 | 14 | 179 |
| California | 2,688 | 200,753 | 5,840 | 440 | 453 | 500,507 | 8,479 |
| Colorado | 4,288 | 356,292 | 7,438 | 220 | 683 | 903,328 | 1,136 |
| Florida | 42 | 3,407 | | 143 | 6 | 1,961 | 60 |
| Idaho | 3,729 | 161,423 | 10,059 | | 863 | 1,557,223 | |
| Montana | 2,650 | 157,438 | 11,787 | | 403 | 626,364 | 62 |
| Nebraska | 40 | 9,456 | 608 | | | | |
| Nevada | 506 | 70,939 | 3,043 | | 118 | 325,364 | |
| New Hampshire | 19 | 195 | 12 | | | | |
| New Mexico | 1,809 | 146,047 | 3,147 | 294 | 469 | 323,868 | 27,420 |
| North Carolina | 289 | 1,436 | 59 | 118 | 34 | 309 | |
| Oklahoma | 56 | 3,292 | 258 | | | | |
| Oregon | 2,120 | 143,514 | 7,787 | 20 | 476 | 684,274 | 883 |
| South Dakota | 765 | 32,713 | 2,931 | | 3 | 4,025 | |
| Tennessee | 105 | 890 | 8 | 7 | 8 | 148 | |
| Utah | 7,310 | 164,278 | 7,311 | 175 | 1,728 | 783,471 | |
| Virginia | 229 | 2,126 | 21 | | 5 | 93 | |
| Washington | 799 | 24,554 | 1,771 | | 135 | 172,481 | |
| West Virginia | 7 | 58 | | | 1 | 16 | |
| Wyoming | 1,155 | 137,558 | 4,381 | | 317 | 670,130 | |
| Total, 1922 | 30,147 | 1,915,113 | 69,640 | 1,888 | 5,811 | 6,851,690 | 39,889 |
| Total, 1921 | 31,027 | 1,999,680 | 78,115 | 2,453 | 6,214 | 6,936,377 | 43,574 |

ECONOMIC CONDITION OF LIVESTOCK INDUSTRY.

During the last year the sheep industry has staged a wonderful comeback. The rapid recovery in the price of wool, together with the strong demand for lambs for fattening purposes, made more general by the undoubted shortage in this class of stock, gave the flock masters excellent returns. With the improved conditions the demand for sheep by men who desired to get into the business forced up prices. A break in the price of wool in June, 1923, brought a comparatively small loss to the wool producers themselves, the majority having sold their wool early in the spring. The cattle industry, however, has shown little or no recuperation. The demand for young steers from the southwestern ranges in the spring of 1923 was disappointingly low, and many cattlemen were unable to liquidate their indebtedness. If a strong demand for young stock and feeders does not materialize this coming fall, many of the range cattlemen of the West will undoubtedly find themselves in a very precarious position.

In order to assist all classes of stockmen using the national forests, the policy was continued of dividing the payment of grazing fees above a minimum of $10 into two installments, the first to be paid at the time the stock entered the forest and the second in the fall. Every possible leniency has been shown the stockmen who were unable to meet their grazing payments for the season of 1921. It will be remembered that early in that year Congress, upon recommendation of the Secretary of Agriculture, authorized a postponement to September 1 of the payment of all grazing fees for the calendar year 1921. Conditions not having improved, Congress later postponed the date until December 1 in order that the stockmen

might secure funds from the sale of surplus cattle at the end of the grazing season.

The following table shows the number of delinquents and the total amount of unpaid fees on July 1, 1923, for the grazing seasons of 1921 and 1922:

*Delinquent grazing fees, fiscal years 1921 and 1922.*

| District. | Number of permittees. | Amount. | District. | Number of permittees. | Amount. |
|---|---|---|---|---|---|
| 1 | 66 | $2,691.53 | 6 | 148 | $5,307.24 |
| 2 | 248 | 12,888.08 | 7 | 26 | 480.94 |
| 3 | 409 | 56,281.11 | | | |
| 4 | 146 | 3,649.70 | Total | 1,056 | 81,890.91 |
| 5 | 13 | 592.31 | | | |

It is gratifying to observe that the total delinquency for these two years of privation and hardship among the cattlemen is less than 2 per cent of the grazing receipts for these years. Probably a portion of this will have to be dropped from further consideration as uncollectible, the majority of the delinquent owners having been forced to dispose of their livestock and go out of the business. Considering the wide distress among livestock owners during these years, this showing is better than was to be expected.

PENDING CHANGES IN GRAZING REGULATIONS AND PROCEDURE.

The regulations and instructions now governing the use of national forest ranges were made the subject of careful study with a view to their thorough revision. In this study an earnest effort was made not only to improve the regulations from the standpoint of administrative methods and practice, but also to introduce such modifications as would best serve the interests both of the stockmen and of the public, by promoting more stable use of the ranges and by helping to rehabilitate the industry after the period of depression through which it has passed. The leading changes proposed are—

(1) Grazing fees amounting to $10 or more may be paid regularly hereafter in two installments.

(2) Term permits issued in 1925 will run to the close of the 10-year period, expiring in 1934. On these term permits, however, reductions in the number of stock grazed may be made at the end of any year if necessary to prevent damage to the range, forest growth, or watershed, and at the expiration of the first five years of the period a reduction may be made to admit to the range new applicants properly qualified or to allow increases to small permittees. The amount of this reduction, taken together with all reductions made for protection during the 5-year period, will not exceed 10 per cent.

(3) What will be known as an "exemption limit" will be established, between the present protective and maximum limits, below which permittees engaged permanently in livestock production will not be called upon to make reductions in favor of new applicants not wholly engaged in stock grazing as their means of livelihood.

(4) No limitations will be placed upon the frequency of sales of livestock accompanied by waivers of grazing preferences. The pur-

pose of this change is to allow permittees more opportunity to sell at favorable terms and to facilitate the purchase of livestock grazed under permit by persons wishing to engage in the business.

These and many other changes were first drafted by a committee of forest officers expert in grazing matters, working with a committee of practical stockmen representative of the entire range country. Later on, after review by me, they were again submitted to the committee of stockmen for further discussion and such recommendations as in their judgment seemed advisable. It is believed that the new regulations will be satisfactory to the permittees and will prove of decided value to the livestock interests, while safeguarding all the interests of the Government and the public and promoting the conservation and fullest use of the forage resource.

### RANGE APPRAISAL.

The range-appraisal work, which has been conducted for nearly two years, is practically closed, and the review of the reports, harmonizing of various recommendations, and final adjustment of the grazing fees in accordance with the figures shown by the appraisal are now in progress. No figures are yet available upon which to forecast what the new grazing fees will be. Before final action is taken on the proposed charges they will be placed before representatives of the various livestock associations for a full, friendly discussion, and such changes will be made as seem justified by the facts presented. When the figures are correlated and properly tabulated the Forest Service will for the first time have comprehensive and dependable data on (1) the commercial value of comparable private lands used in reasonably large bodies for the grazing of livestock under conditions similar to those found on the national forests; (2) the value of the individual grazing allotments or districts in the national forests, considering their accessibility and their forage and water resources; (3) the estimates presented by stockmen as to the cost of compliance with the national forest grazing regulations, which many permittees honestly believe are frequently a burden to the industry; and (4) the actual grazing needs of the stockmen and farmers in the immediate vicinity of each national forest.

The new grazing fees will be fair and reasonable valuations of the respective ranges, based upon the commercial value of comparable private lands, but with full consideration of the cost of complying with the grazing regulations on national forests and of the public and community benefits sought under public range administration. These include the correlation of range use with local ranch lands and water developments and the promotion of agricultural settlement. The new fees will go into effect with the grazing season of 1925.

### COOPERATION WITH PERMITTEES.

Cooperation with permittees has been an underlying principle in national forest range management almost from the beginning. The range users, through selected advisory boards, are given a wide share of responsibility in the administration of grazing. This includes such matters as the opening up of stock trails, the improvement of

springs, the erection of drift fences to keep the stock on their proper ranges, the eradication of poisonous plants, and range adjustments between classes of stock.

Another form of cooperation is the enforcement of special rules adopted by a majority of the users of a particular range and approved by the Forest Service as fair and beneficial. These rules deal with such matters as the placing of salt on the ranges, the handling of round-ups, and the exclusive use of purebred bulls.

Special rules are now in force on the national forests through cooperation of this character with 733 local livestock associations. Each represents a majority of the permittees using a particular range. Out of the many thousand permittees affected by these special rules, the number who have opposed the collection of assessments by the associations or attempted to evade the requirements is extremely small. The livestock associations, furthermore, have been of enormous assistance to the Forest Service by affording responsible local agencies with whom many phases of administration, such as the proper seasons for grazing each type of range, rotation grazing, and other improvements in range use, can be discussed and often directly settled.

In revising the grazing regulations it is proposed to extend the cooperation with stockmen still further through the issuance, in some instances, of a single grazing permit to an association for the total number of stock which its members are entitled to graze on the forest. A broader responsibility will thereby be placed upon the association for the enforcement of satisfactory management of stock on the range. Where the associations represent communities in which the stock interests are closely related it is felt that this new plan will be acceptable to the stockmen, as it gives them a larger responsibility in local range management than they have heretofore had.

One of the outstanding examples of cooperation was the revision of the grazing manual by forest officers in conference with a committee representing the various livestock associations in the western range States. This committee discussed the proposed changes, suggested modifications, and in many ways aided materially in harmonizing points of view and improving the regulations. In the redetermination of grazing fees the cooperation of the livestock associations was sought and will be an essential factor in arriving at the final result.

### STABILITY OF GRAZING PRIVILEGES.

There has been a feeling among range livestock men that the grazing privileges on the national forests were not stable. The permits have been revocable at the discretion of the Secretary of Agriculture, and the policy of the service has been to encourage new settlers by granting them limited grazing privileges on fully occupied ranges through moderate reductions in the numbers of stock run by the larger and older permittees.

The range appraisal has demonstrated that national-forest permittees have, in fact, been exceptionally secure in their tenure of range use in comparison with what has happened on other large bodies of lands leased for grazing, whether State, Indian, or private.

Thousands of our permittees have been using the forest range year after year from the first season when permits were issued and are grazing practically on the same ranges and about the same number of stock as originally. Some owners who once held permits for large numbers of stock are now grazing smaller herds, but in a majority of these cases the reduction is due to business changes rather than the effect of national-forest regulations. Where the contrary was the case, the reduction was made for the benefit of the community, with a view to a fairer distribution of the grazing privileges.

In the early days of the service, when there were yet many vacant homesteads on the public domain, the policy of aiding and encouraging new settlers by grazing permits on a near-by forest was fully justified, even where it involved reductions in the herds of the larger permittees. That condition, however, has changed so largely that such reductions are now seldom necessary. The available agricultural lands near or adjacent to the national forests are practically gone, except here and there where they can be reclaimed through irrigation projects. With this true, it is believed that the issuance of 10-year permits and the creation of the exemption limit will make the tenure and stability of grazing privileges as satisfactory as possible, considering that the Federal Government must retain in its hands the control of its property both to insure its sustained productivity and to accomplish the maximum public benefits from its use.

### THE UNRESERVED PUBLIC RANGES.

No small part of the instability in the western livestock industry has resulted from the unregulated use of some 175,000,000 acres of open and unreserved public-range lands. Since the earliest days of livestock production in the West these areas have been open-grazing commons, utilized without let or hindrance on the principle of "first come, first served." Except where particular stock outfits have been able to control public land through the ownership of watering places or other facilities, competitive and unrestrained use has usually brought about a striking deterioration in the productivity of these areas. They no longer contribute to the production of livestock products what they originally afforded or what they might afford if properly grazed.

A large number of western stockmen are dependent upon these ranges for a part of the season's pasturage, but with no system of allotment or control the availability of the public lands in connection with established ranches has become more and more of a gambler's chance. In many cases open ranges are required for spring and fall grazing by livestock whose winter feed is assured on ranches and whose summer pasturage is assured on national-forest allotments. In the cases of those flock masters the deterioration of the open ranges and the uncertainty attending their use has become an element of business instability of far-reaching proportions.

There is a clear need for a form of public-range administration which will in some degree restore their original forage-producing value and afford security of use by the livestock producers most equitably entitled to them, a scheme of administration more or less comparable to that now applied on the national forests. No one appreciates this situation more clearly than the western stockmen

themselves, who are prepared to assist, through local cooperative associations, in working out a reasonable plan of public-range regulation. The principle of local option might well be followed in undertaking a plan of this character, basing the need for its application in particular localities upon the judgment of the range users themselves. The economic difficulties which the livestock industry of the Western States is now seeking to overcome have emphasized more clearly than before the weakness of the industry at this point. And in its efforts to aid the livestock industry in attaining a more stable and profitable footing it is doubtful if there is any one thing on the part of the Federal Government which would accomplish more in the long run than to provide some flexible plan for regulating the use of the open public ranges in cooperation with the stock growers directly concerned.

### RANGE IMPROVEMENT FUNDS NEEDED.

Additional funds are needed for the equipment of national forest ranges with boundary and division fences, the development of water, and the eradication of poisonous plants. Because of the urgent need of improvements for fire control it has been possible hitherto to devote only a relatively small sum to range improvements. Such improvements as have been erected have been largely paid for by grazing permittees, but it is doubtful if much further assistance can be obtained from them, at least without substantial cooperation from the Government. Furthermore, to facilitate the best management of the ranges, it is urgent that the Government itself own at least a major interest in the improvements built on Government land. Many national forest ranges can not be adequately protected or conserved without the construction of boundary or division fences. Other ranges can not be utilized without developing water or eradicating poisonous plants. An ultimate expenditure of from two to three million dollars will be needed to obtain full use and economic returns from the national forest ranges without subjecting them to deterioration. The urgent projects which have been surveyed and which should be pushed immediately will cost approximately $170,000.

### RECREATION AND GAME.

The national forests, because of their public character, great scenic attractiveness, widespread distribution, and proximity to the centers of population of the States in which they are situated, have always been the natural recreational fields for large numbers of people. In earlier years, however, their relative inaccessibility, due to the lack of roads and trails, kept the number of visitors down, and consequently recreation offered few problems of management or protection. The results of the successive Federal road acts and the phenomenal growth in the use of motor vehicles have now made recreation in the national forests a major activity which, though relatively unproductive of money returns, is of outstanding public importance. The number of people resorting to the national forests for health and pleasure has borne almost a constant relation to the increasing mileage of constructed road and the number of personally owned motor cars.

The first comprehensive attempt to estimate the numbers of people using the national forests for recreation was made in 1916, when an estimated total of 2,370,000 persons was reported. Recent verifications of succeeding estimates yield the following figures:

| Year. | Visitors. | Year. | Visitors. |
|---|---|---|---|
| 1917 | 3,160,300 | 1920 | 4,832,671 |
| 1918 | 3,322,565 | 1921 | 5,433,420 |
| 1919 | 3,964,344 | 1922 | 6,172,942 |

Thus in six years the estimated number of visitors virtually doubled, and all indications point to a continued increase for years to come.

The use of the national forests for recreation is in all respects deserving of encouragement. It means for no small part of our population a valuable opportunity and privilege. Properly provided for, recreational use will add valuable elements to our national life without seriously impairing the capacity of the forests to create wealth or render other public services. But it has become clear that if the annual occupancy of the national forests by increasing millions of people is not properly provided for serious consequences to public health and property will develop. Those frequenting the forests naturally concentrate at the points offering the most attractive camping facilities or the best natural opportunities for outdoor play. In doing so they may create bad sanitary conditions, which menace not only their own health and that of residents within the forests, but also the well-being of remote residents on the lower reaches of the streams and of municipalities dependent on such streams for their water supply. They may also create a fire hazard which adds materially to the difficulty of protecting the public properties.

The solution of this problem does not lie in the restriction of recreational use, but in making adequate provision for it by the installation of simple facilities essential to public health, comfort, and security, such as toilets, water supplies, garbage pits or incinerators, fireplaces, etc. In 1922 a study was made of 960 specific camp grounds used by 1,355,000 people annually. For the proper development and protection of these camps facilities are required to a total estimated cost of $122,259, which would amount approximately to 2 cents for each person using the camp grounds in a single year. Most of the facilities needed bear directly on the problems of public health and protection of public property. To date the total sum appropriated to meet these requirements has been only $25,000. This has been wholly inadequate to meet the needs of 6,000,000 people. An expenditure roughly amounting to 5 cents for each person using the forests annually for recreation purposes would permit the installation of practically all of the most necessary facilities. Considering the numbers of persons who would be benefited by such an expenditure, the probable improvement to the public health, and the reduction in fire losses, it would be a distinct economy to make this expenditure as rapidly as the financial situation of the Government will permit.

Forested areas are the natural abiding place of game animals of every kind, while the streams that find their sources therein furnish

ideal breeding grounds for fish. One of the important duties of forest officers in the field is the protection of these resources, which are related to the use of the forests as recreation grounds.

The question is constantly asked, Are game animals increasing or decreasing? The annual game reports submitted by each forest supervisor show that, contrary to the general opinion, the larger animals, especially deer, while increasing only in certain regions, are probably about holding their own. On the game preserve in the Kaibab National Forest in Arizona, with 20,000 deer, on the Trinity National Forest in California, with 26,000, and on the California National Forest in the same State, with 40,000, the numbers are increasing to a point where the disposition of the surplus is already a problem. This question as it relates to the Kaibab herd is now under consideration in cooperation with the State and the Biological Survey.

The valuable species of fish, however, are undoubtedly being depleted faster than the streams are restocked. It is generally admitted that the chief cause for fished-out streams, as well as depleted hunting grounds, is the automobile. The extension of excellent roads into regions hitherto almost inaccessible save on horseback or on foot brings people into the forests by thousands from increasing distances. Streams that a few years ago furnished excellent sport for a few adventurous fishermen who made their way over rough trails and down deep canyons are now brought within easy reach by road.

The automobile and good roads are, of course, here to stay. The situation must be met not only through wider and more frequent restocking of the streams, radical regulation of the number of fish that can be taken by each person each day, cutting down bag limits and open seasons, and strict game-law enforcement, but also by the development of scientific game administration based on thorough knowledge of the requirements, habits, breeding capacity, and life history of the various species, to the end that conditions favorable to their production up to the limit of what is desirable, all things considered, may be maintained or provided. The wild-life resources of the national forests must be administered, fostered, and utilized much as are the timber and forage resources. The cost of this activity, in common with providing facilities for recreation and conserving the sources of water, will never be recovered in the form of commercial receipts, but is justified by the valuable public service which the national forests can thus contribute.

Game refuges and fish-breeding streams or ponds should be set aside to provide for protected breeding, careful consideration must be given to available food supplies, and a system of regulated use devised that will prevent depletion. The Forest Service is working on some of these problems in cooperation with the Biological Survey and the Bureau of Fisheries. It is also collaborating to the fullest extent possible with the game departments of the respective States in the enforcement of State laws, the selection and special protection of State preserves, and the study of local situations and needs with a view to bettering fish and game administration.

The last two or three seasons, both summer and winter, have been favorable to the elk in the Yellowstone region. Calf crops have

been unusually large and the herds are increasing. This has occurred in the past, and if the history of the elk is repeated there will be a gradual increase in numbers until an unusually hard winter such as occurred in 1910–11 or in 1919–20 takes a heavy toll. This apparently is nature's method of taking care of the surplus.

There is abundant summer range for even larger elk herds, but winter feed is limited. The Government lands lying immediately north of the Yellowstone Park, along the Yellowstone River, have been withdrawn by presidential proclamation pending action by Congress. They could be added either to the Yellowstone National Park or to the adjacent Absaroka National Forest. Unfortunately, local public sentiment is opposed to such action, and the preservation of this comparatively small piece of winter range appears no nearer solution than it was 10 years ago, when first taken up. The area contains 56,000 acres, of which 12,000 acres are unreserved and unappropriated public domain, 18,000 acres are the property of the Northern Pacific Railroad, 2,000 acres are Montana school lands, and 24,000 acres are private grazing and agricultural lands. Only 2,600 acres of the latter are actually used for farming purposes, the rest being pure grazing lands. The Forest Service has already withdrawn about 65,000 acres of the same kind of land adjoining this tract to the east, within the Absaroka National Forest, for the use of the elk in winter.

That part of the area belonging to the Northern Pacific Railroad is being withheld from sale or lease pending some action by Congress, with the probability of an exchange if the rest of the area is set aside for winter elk range. The land which is in the hands of the settlers can not, of course, be secured except through purchase. A great step forward will be made, however, if through congressional action the lands belonging to the Government are added to the national forest or national park.

As on a number of other protected Federal areas, the buffalo, deer, and elk in the Wichita game preserve in Oklahoma have increased to a point where it will become necessary to dispose of a number of them each year so that the herds can be kept within the grazing capacity of the land available. The matter is now being carefully considered with a view to working out a plan of disposal which will best meet all public requirements.

Special problems are constantly arising in connection with the recreational and wild-life resources of the national forests. The American people are advancing rapidly in appreciation of the great social value of forest spaces and their wild life. A plea is now made for the reservation of certain national forests, or parts of them, from the commercial use of timber and forage, or even from customary forms of recreation, like public camp grounds, summer homes, and hotels—indeed, from the very building of roads which would make these areas accessible to considerable numbers of visitors. What these people want is not parks but stretches of untrammeled wilderness, deliberately reserved as such, which only a few of the more hardy and "elect" among the seekers of the out of doors can penetrate, relying upon their unaided skill in woodcraft. This plea has been made particularly with reference to the Kaibab National Forest in Arizona and the Superior National Forest in Minnesota, or parts of them. It expresses an admirable conception of the value of the

forest frontier to the physical and social health of the American people. It is a wholesome reaction from the multiplication of improved roads and automobiles.

The national forests contain many areas of rugged mountains, which do and always will perform this distinctive service to the American out of doors. The deliberate withholding from commercial use, road building, or other forms of local development which would naturally take place can not be decided offhand without consideration of all the interests that may be involved and the sacrifices that may be entailed. Secretary James Wilson's instructions that the national forests be administered "for the greatest good of the greatest number in the long run" are as sound in 1923 as in 1905. But the greatest good of the greatest number of American people in the long run undoubtedly does call for abundant opportunities for a rugged and unspoiled taking to the woods. This question can only be answered by a broadgauge weighing of all the forms of service, social as well as economic, which a national forest can render, and then planning its development and administration in harmony with its greatest possible service to the public.

## WATER POWER.

The following tabulation contains data concerning water-power permits or easements granted by the Department of Agriculture under former legislation and in effect on June 30, 1923:

*Water-power development and transmission-line easements under permit or easement, fiscal year 1923.*

| Class of permits or easements | Transmission lines only. | | | Power projects (reservoirs, conduits, and power houses). | | Total number permits or easements. |
|---|---|---|---|---|---|---|
| | Number permits or easements. | Length in miles. | | Number permits or easements. | Estimated average output (in horsepower) at minimum discharge. | |
| | | Within national forest boundaries. | On national forest land. | | | |
| Permits or easements in force at close of fiscal year: | | | | | | |
| Rental— | | | | | | |
| Preliminary | | | | 3 | 900.0 | 3 |
| Final | 151 | 1,133.03 | 836.41 | 81 | 594,086.0 | 232 |
| Free permits or easements | 21 | 154.02 | 120.96 | 93 | 24,610.4 | 114 |
| Total | 172 | 1,287.05 | 957.37 | 177 | 619,596.4 | 349 |
| Construction completed at close of fiscal year: | | | | | | |
| Rental permits or easements | 151 | 1,133.03 | 836.41 | 71 | 374,501.0 | 222 |
| Free permits or easements | 21 | 154.02 | 120.96 | 82 | 7,315.4 | 103 |
| Total | 172 | 1,287.05 | 957.37 | 153 | 381,816.4 | 325 |
| Construction incomplete at close of fiscal year: | | | | | | |
| Rental permits or easements | | | | 9 | 217,745.0 | 9 |
| Free permits or easements | | | | 10 | 17,280.0 | 10 |
| Total | | | | 19 | 235,025.0 | 19 |
| Construction not started at close of fiscal year: | | | | | | |
| Rental permits or easements | | | | 4 | 2,740.0 | 4 |
| Free permits or easements | | | | 1 | 15.0 | 1 |
| Total | | | | 5 | 2,755.0 | 5 |

During the year 57 applications for projects in whole or in part on national forest land were received by the Federal Power Commission. This exceeds by 12 the number for the preceding year, and is over half the total received during the year for permits on all Government lands and navigable streams.

The Federal Power Commission referred 33 applications to the Forest Service for engineering report and 20 for administrative report. At the end of the year the Forest Service was supervising and inspecting the operations of 78 permittees or licensees under the Federal water power act. On 16 of these cases, all of which are in Alaska, it is supervising the stream-gauging operations also.

The utilization of the pulpwood resources in the Tongass Forest in Alaska depends very largely upon the development of water power. As a result of field investigations, especially those made by the Forest Service during the past three years, a considerable number of promising sites have been discovered. Several applications for permit or license have been filed with the Federal Power Commission, the expressed purpose being the utilization of power in the manufacture of wood pulp. By law competition is essential to the sale of national forest timber. To carry out this requirement and comply with the provisions of the Federal water power act, the Forest Service and Federal Power Commission have entered into an agreement under which action upon applications for water power and timber will proceed simultaneously as far as possible. After the completion of advertising and the submission of bids for the timber the Forest Service and the Power Commission will determine to which applicant, ordinarily the highest bidder, both timber and power permit shall be awarded. Both timber award and power permit are subject to cancellation if the right to either privilege is lost. The same period will be allowed for the completion of surveys and plans for timber and power development, and the water-power license and the final timber contract will be acted upon as nearly as possible at the same time.

This joint action places all bidders for national forest timber on an equality and enables the organizers of pulp and paper enterprises to have equal assurance in regard to both timber supply and water power during the period of investigation and plan making when the expenditure of considerable sums of money is necessary.

### ROADS AND TRAILS.

From January 1, 1922, to June 30, 1923, greater progress was made in road and trail work on the national forests than in any preceding period of the same length. The following table shows the accomplishments during the fiscal year 1923 and the total accomplishments and expenditure to the close of that year:

*Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States.*

| State. | Fiscal year 1923. | | Total to June 30, 1923. | | | | Expenditures to June 30, 1923. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Constructed. | | Constructed. | | Maintained. | | Federal funds. | Co-operative funds. | Total funds. |
| | Roads. | Trails. | Roads. | Trails. | Roads. | Trails. | | | |
| | *Miles.* | *Miles.* | *Miles.* | *Miles.* | *Miles.* | *Miles.* | | | |
| Alabama | 10.0 | | 10.0 | | 10.0 | 19.0 | $5,738.74 | | $5,738.74 |
| Alaska | 19.1 | 40.6 | 90.2 | 96.7 | 133.2 | 96.7 | 895,613.19 | $171,243.56 | 1,066,856.75 |
| Arizona | 136.7 | 313.8 | 465.6 | 993.8 | 578.1 | 506.8 | 1,305,519.38 | 660,725.20 | 1,966,244.58 |
| Arkansas | 29.6 | 62.3 | 108.5 | 133.4 | 66.8 | 267.3 | 302,644.32 | 24,184.93 | 326,829.25 |
| California | 140.5 | 463.5 | 462.7 | 1,211.2 | 1,540.7 | 5,029.4 | 3,478,506.08 | 978,348.99 | 4,456,855.07 |
| Colorado | 122.5 | 175.9 | 597.2 | 807.1 | 371.1 | 1,383.5 | 2,180,422.56 | 517,220.17 | 2,697,642.73 |
| Florida | 4.0 | | 42.4 | | 23.7 | 36.5 | 85,281.88 | 63,347.39 | 148,629.27 |
| Georgia | 5.0 | 34.0 | 13.5 | 69.4 | 10.0 | 114.6 | 127,583.32 | | 127,583.32 |
| Idaho | 206.7 | 647.4 | 958.1 | 1,946.7 | 380.6 | 5,071.0 | 3,431,191.47 | 891,895.01 | 4,323,086.48 |
| Kansas | | | 3.4 | | | | 2,111.51 | | 2,111.51 |
| Maine | 4.3 | | 4.3 | 30.0 | 7.1 | 32.3 | 10,344.08 | | 10,344.08 |
| Michigan | | | 40.4 | | 27.0 | | 6,318.98 | 186.95 | 6,505.93 |
| Minnesota | 25.0 | .3 | 70.5 | 39.0 | 30.0 | 18.0 | 158,371.88 | 92,189.48 | 250,561.36 |
| Montana | 41.2 | 380.5 | 388.8 | 683.7 | 512.8 | 5,315.8 | 1,893,354.73 | 354,786.57 | 2,248,141.30 |
| Nebraska | 10.5 | | 24.6 | | 2.0 | | 18,043.86 | | 18,043.86 |
| Nevada | 3.0 | 143.3 | 299.3 | 340.8 | 142.7 | 82.0 | 261,411.65 | 98,163.46 | 359,575.11 |
| New Hampshire | 6.6 | 22.1 | 11.1 | 258.1 | 31.7 | 237.3 | 39,351.68 | 220.25 | 39,571.93 |
| New Mexico | 59.2 | 403.8 | 293.9 | 870.7 | 220.3 | 860.8 | 1,191,822.38 | 191,264.71 | 1,383,087.09 |
| North Carolina | 11.0 | 70.8 | 61.9 | 110.9 | 41.5 | 347.1 | 202,727.60 | 34,056.37 | 236,783.97 |
| North Dakota | | | 1.0 | | | | 65.75 | | 65.75 |
| Oklahoma | 3.0 | | 6.0 | | 19.0 | | 14,488.95 | 1,937.36 | 16,426.31 |
| Oregon | 395.4 | 354.3 | 1,147.4 | 944.6 | 1,341.3 | 3,507.0 | 3,421,762.02 | 2,080,008.66 | 5,501,770.68 |
| Porto Rico | | 14.0 | | 30.3 | | 30.3 | 8,672.64 | | 8,672.64 |
| South Carolina | 2.0 | 4.0 | 5.1 | 4.0 | 22.8 | | 50,432.32 | 11,900.00 | 62,332.32 |
| South Dakota | 34.4 | | 132.1 | 20.6 | 74.6 | 3.3 | 293,330.71 | 114,201.31 | 407,532.02 |
| Tennessee | | 105.2 | 12.2 | 151.7 | 11.0 | 281.2 | 103,872.97 | 80,050.00 | 183,922.97 |
| Utah | 472.6 | 279.0 | 801.1 | 740.0 | 485.7 | 651.0 | 1,216,473.65 | 624,262.31 | 1,840,735.96 |
| Virginia | 17.4 | 102.2 | 24.5 | 158.9 | 130.8 | 364.7 | 136,828.07 | 10,759.91 | 147,587.98 |
| Washington | 127.6 | 335.3 | 367.6 | 674.8 | 380.4 | 3,762.0 | 2,339,951.03 | 912,105.45 | 3,252,056.48 |
| West Virginia | | 20.5 | | 20.5 | 36.5 | 143.5 | 4,913.25 | 500.00 | 5,413.25 |
| Wyoming | 136.9 | 150.7 | 430.3 | 338.4 | 611.5 | 917.5 | 1,371,868.42 | 242,285.04 | 1,614,153.46 |
| Total | 2,024.2 | 4,123.5 | 6,873.7 | 10,675.3 | 7,242.9 | 29,078.6 | 24,559,019.07 | 8,155,843.08 | 32,714,862.15 |

In the calendar year 1922, 1,836 miles of road and 4,379 miles of trail were constructed or improved, and 5,525 miles of road and 23,107 miles of trail were maintained. For the calendar year 1921 the corresponding figures were 1,104 miles of road construction and improvement, 2,959 miles of trail construction, 3,007 miles of road maintenance, and 4,294 miles of trail maintenance. The progress on the small road projects and on the trails constructed under the direct supervision of the Forest Service has been much more rapid than on the larger, more difficult and expensive projects under the supervision of the Bureau of Public Roads. This is not at all surprising. The minor roads work of the Forest Service embraces numerous small projects scattered among many forests; the work is simple; very little time is required for surveys and preliminary estimates; and construction work can be carried on rapidly. Also these projects are handled entirely by day labor.

The projects supervised by the Bureau of Public Roads and approved from the 1922 and 1923 fiscal year appropriations have now in very large measure passed the survey and preliminary stages, and the coming year will show greater results in construction and a greater expenditure than in any preceding year. Some increase in

the minor work is also to be expected, but as now carried on it is close to the maximum possible under the present appropriations.

The following tabulation shows the condition of the five forest-road appropriations on July 1, 1923:

*Condition of road appropriations on July 1, 1923.*

| | Total appropriations to June 30, 1923. | Total expenditures. | Unexpended balance. |
|---|---|---|---|
| Ten per cent | $3,541,840 | $2,985,211 | $556,629 |
| Section 8 | 7,000,000 | 5,492,281 | 1,507,719 |
| Federal forest-road construction | 9,000,000 | 8,494,643 | 505,357 |
| Forest highway | 9,500,000 | 2,855,589 | 6,644,411 |
| Forest development | 5,500,000 | 3,376,143 | 2,123,857 |
| Total | 34,541,840 | 23,203,867 | 11,337,973 |

The distribution among States of the appropriations available for expenditure prior to July 1, 1923, and of the appropriations which on that date were made available for expenditure or against which obligations may legally be incurred is shown in the following tabulation:

*Distribution among the States of the total appropriations and of the apportionment for the fiscal year 1924.*

| State. | 10 per cent fund. | | Section 8 fund. | | Federal forest road construction fund total. | Forest highway fund. | | Forest development fund. | | Grand total. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fiscal year 1924. | Total. | Fiscal year 1924. | Total. | | Fiscal year 1924. | Total. | Fiscal year 1924. | Total. | |
| Alabama | $85.96 | $358.48 | (1) | $60.00 | $737.37 | $2,044 | $6,924 | $3,104 | $8,903 | $16,982.85 |
| Alaska | 6,311.35 | 80,270.08 | $43,764 | 376,500.75 | 204,980.50 | 361,046 | 1,331,317 | 25,626 | 75,848 | 2,067,907.06 |
| Arizona | 42,331.19 | 404,366.97 | 54,854 | 481,836.75 | 467,556.56 | 217,759 | 815,948 | 138,346 | 419,068 | 2,584,053.00 |
| Arkansas | 3,806.86 | 53,960.38 | 9,633 | 153,478.72 | 131,678.65 | 25,305 | 95,670 | 37,798 | 110,371 | 545,158.75 |
| California | 127,335.87 | 607,635.20 | 126,617 | 1,169,534.56 | 1,180,186.98 | 533,915 | 1,994,786 | 347,724 | 1,051,546 | 6,003,688.74 |
| Colorado | 46,496.58 | 391,048.78 | 67,814 | 607,373.61 | 788,579.96 | 263,748 | 980,806 | 171,548 | 507,908 | 3,275,517.69 |
| Florida | 1,824.33 | 18,129.94 | (2) | 15,392.86 | 4,552.07 | 9,105 | 34,223 | 4,490 | 13,220 | 85,517.87 |
| Georgia | 706.08 | 3,373.67 | (1) | 517.68 | 8,983.26 | 4,989 | 18,344 | 10,578 | 30,925 | 62,143.61 |
| Idaho | 59,482.35 | 466,904.71 | 113,793 | 943,548.04 | 1,388,598.21 | 394,829 | 1,492,723 | 589,402 | 1,678,058 | 5,969,338.46 |
| Kansas | | 1,867.27 | | | | | | | | 1,867.27 |
| Maine | 202.50 | 964.12 | (1) | 169.01 | 3,729.79 | 988 | 3,748 | 2,426 | 7,180 | 15,790.92 |
| Michigan | 49.43 | 790.77 | (2) | 15.00 | 3,000.00 | 1,828 | 5,466 | 3,376 | 9,596 | 18,867.77 |
| Minnesota | 1,075.32 | 14,557.44 | (2) | 7,637.65 | 110,374.80 | 23,655 | 84,584 | 21,918 | 87,539 | 304,792.89 |
| Montana | 30,239.38 | 388,390.90 | 65,215 | 602,074.00 | 758,553.19 | 317,192 | 1,196,078 | 405,084 | 979,699 | 3,925,223.61 |
| Nebraska | 1,731.99 | 11,812.19 | (2) | 26.98 | | 4,003 | 15,068 | 5,466 | 16,625 | 43,532.17 |
| Nevada | 11,331.92 | 100,382.13 | 17,668 | 157,486.05 | 82,822.66 | 75,915 | 283,899 | 13,702 | 69,079 | 693,668.84 |
| New Hampshire | 2,541.39 | 12,387.19 | (1) | 181.10 | 10,784.46 | 12,504 | 47,798 | 12,772 | 37,048 | 108,198.75 |
| New Mexico | 17,894.75 | 239,970.59 | 38,124 | 344,935.51 | 521,904.39 | 164,330 | 622,588 | 94,816 | 314,468 | 2,043,866.66 |
| North Carolina | 3,364.01 | 16,294.47 | (1) | 91,741.49 | 30,208.66 | 10,391 | 38,247 | 24,798 | 71,782 | 248,273.62 |
| North Dakota | | 45.75 | | 15.00 | | | | | | 60.75 |
| Oklahoma | 654.27 | 5,295.87 | (2) | 49.45 | 2,753.75 | 2,024 | 7,669 | 4,734 | 13,498 | 29,266.07 |
| Oregon | 67,244.78 | 442,896.00 | 136,587 | 1,119,770.80 | 1,091,284.66 | 453,395 | 1,610,504 | 440,922 | 1,159,477 | 5,423,932.46 |
| Pennsylvania | | | (1) | | | 1,189 | 1,189 | 9,208 | 9,208 | 10,397.00 |
| Porto Rico | | 3.70 | (2) | 15.00 | 3,336.11 | 521 | 1,975 | 2,734 | 8,078 | 13,407.81 |
| South Carolina | 70.48 | 374.94 | (1) | 188.70 | 48,275.94 | 586 | 2,158 | 4,712 | 13,416 | 64,413.58 |
| South Dakota | 9,919.66 | 77,849.58 | 7,497 | 67,751.41 | 79,864.55 | 27,563 | 105,116 | 11,200 | 75,339 | 405,920.54 |
| Tennessee | 1,295.06 | 8,526.62 | (1) | 59,758.11 | 30,001.96 | 7,102 | 27,998 | 12,442 | 35,685 | 161,969.69 |
| Utah | 27,060.06 | 242,964.59 | 38,447 | 357,310.39 | 475,034.98 | 135,056 | 506,832 | 62,872 | 227,130 | 1,809,271.96 |
| Virginia | 2,502.99 | 14,453.71 | (1) | 2,599.80 | 5,686.58 | 10,657 | 36,797 | 24,660 | 71,172 | 130,709.09 |
| Washington | 34,497.55 | 246,646.31 | 85,880 | 767,900.19 | 727,323.83 | 259,269 | 967,402 | 381,492 | 984,381 | 3,693,653.33 |
| West Virginia | 208.17 | 1,686.58 | (1) | 128.64 | 2,225.80 | 3,561 | 9,612 | 7,782 | 22,384 | 36,037.02 |
| Wyoming | 28,304.78 | 216,200.75 | 45,410 | 369,637.21 | 561,245.97 | 175,531 | 654,531 | 124,268 | 391,369 | 2,192,983.93 |
| Group 1 | | | 13,734 | 13,734.00 | | | | | | 13,734.00 |
| Group 2 | | | 34,963 | 34,963.00 | | | | | | 34,963.00 |
| Special fund | | | 100,000 | 253,668.54 | | | | | | 254,613.37 |
| Equipment and administration | | | | | 275,734.36 | | | | | 280,685.55 |
| Total | 528,569.06 | 4,070,409.68 | 1,000,000 | 8,000,000.00 | 9,000,000.00 | 3,500,000 | 13,000,000 | 3,000,000 | 8,500,000 | 42,570,409.68 |

[1] Group 2.

[2] Group 1.

By the post office appropriation act of June 19, 1922, Congress authorized a forest-road appropriation of $6,500,000 for the fiscal year 1924 and an equal amount for the fiscal year 1925. Of the $6,500,000 authorized for the fiscal year 1924, only $3,000,000 was directly appropriated. However, the Secretary of Agriculture was authorized to apportion the remaining sum of $3,500,000 and to incur obligations against this apportionment.

This constitutes a departure from the previous policy of Congress in appropriating for forest roads and trails. The intent of the legislation is to reduce the amount of undisbursed balances while still permitting work to proceed on the same scale as if the entire $6,500,000 had been directly appropriated. In effect, the total of $6,500,000 is guaranteed, but of this only $3,000,000 is made available for actual expenditure. While it is possible to carry the work on for a limited period under this installment method of making appropriations by drawing in the balances from all road funds in the States where construction has proceeded slowly for one reason or another, it is evident that sooner or later either supplemental amounts must be appropriated outright or the scale of work more than cut in half. This will actually come about not later than July 1, 1924. By that date no further road projects can be programmed or contracted unless additional appropriations taking up substantially the authorizations carried by the act of June 19, 1922, are made.

### MAPS AND SURVEYS.

Forty-three maps of individual national forests on various scales were compiled and drafted by the Forest Service and printed during the fiscal year for administrative use. A number of forest maps were also used for recreation folders, which, with printed information and fire precautions on the reverse side, are issued to the public.

More rapid mapping and surveying of the national forests would greatly assist in fire detection and protection. Approximately 60,000,000 acres—about 33 per cent of the gross area of the forests—are sufficiently well surveyed and mapped to afford adequate assistance in planning and organizing fire protection, leaving 67 per cent of the area greatly in need of further surveys. Of the 146 forests, 47 are entirely without surveys which can be classed as good, 49 forests have less than 50 per cent of their area covered by good surveys, and the remaining 50 forests have from 50 per cent to 100 per cent of their area covered by adequate surveys.

## RESEARCH.

### TIMBER-GROWING INVESTIGATIONS—FOREST EXPERIMENT STATIONS.

Only by intensive management on all the forest lands in the United States can timber production be increased sufficiently to meet our requirements. The wolf will not be driven from the door until four times our present growth of wood is secured. Forest investigations are necessary to develop the technical practices by which this can be done, and forest experiment stations are the cutting edge of the investigative organization in this field. They have a very concrete part to perform in the program of national forestry—to increase our

timber growth from the 14,000,000,000 cubic feet possible under crude methods to the maximum obtainable from the same land by intensive forestry.

A forest experiment station is a group of investigators trained in forestry with headquarters at some central point where facilities for scientific work are available and with a dozen or more field stations located in the principal forest types of the surrounding region. Many of these field stations are placed on private lands under cooperative agreements with the owners. They include nurseries and demonstration plots, where the costs and possibilities of tree planting are worked out; sample thinning and felling areas, where various methods of cutting and natural reseeding are tested; and other plots where accurate measurements are carried on to determine the growth rate of important commercial trees and the yields of wood from stands of different ages. Slash disposal, the protection of forests from fire and other destructive agencies, and the relation between forests and stream flow are also covered in the work plans of forest experiment stations.

The importance of such research is realized when we recall that our annual forest fire loss amounts to over $16,000,000; that we have 81,000,000 acres of denuded and nonrestocking forest lands, a large part of which will require planting; that by managing our forests intelligently we can increase their growth of wood four and one-half times; and that the primary industries which depend upon forests for their raw material have an annual product of $2,500,000,000. The importance of the great interests at stake has led the Forest Service to urge the establishment of forest experiment stations in each of the important timber-producing regions of the United States.

As a part of this general program, two new stations, one in the Northeast and one in the Lake States, began work shortly after July 1 of this year, as a result of the appropriation made by the last Congress. These stations are on a more nearly adequate scale than any of those previously established, both as to personnel and as to equipment. Each of them is regional in character. The northeastern station is studying the forest problems of New England and New York; the Lake States station, those of Michigan, Wisconsin, and Minnesota. The work will be carried on chiefly at several field centers representative of large areas of forest in each region. The stations are first of all familiarizing themselves with the work already under way and developing cooperation with local agencies in the field, so that the investigative work in the region may be coordinated and unified to the advantage of all the forest interests.

Many of the problems which the forest experiment stations study are closely related to those which form part of the work of the agricultural colleges and experiment stations. Joint study with the agricultural colleges and experiment stations of related problems of climate, soil, plant growth, and the economics of land use is obviously desirable. Accordingly, in establishing the headquarters of the two new forest experiment stations cooperation with agricultural colleges in their regions has been arranged for.

Good progress was made during the year in the other regions. Studies of fire damage and of the relation between fire hazard and weather conditions in the Northwest, in California, and in the

Appalachian region contributed valuable information which has resulted in more effective fire protection and promises to lead to further valuable findings. A thorough study by the Appalachian station of the forest plantations on the Biltmore estate in North Carolina, the oldest and most extensive plantations in the region, has furnished an important contribution to the knowledge of species and methods of reforestation in that region. A comprehensive study of the growth of the southern pines by the Southern Forest Experiment Station, in cooperation with the National Research Council and several State forestry departments, is now nearing completion and will furnish much-needed information for the timber owners throughout the South who are seriously considering the continuous production of timber on their lands. The results of several outstanding pieces of research were published during the year.

In furtherance of its program the Forest Service plans, whenever the necessary funds can be made available, to enlarge the small-scale work now under way in the Pacific Northwest and in California by the establishment of stations on the standard set by the last Congress for the Lake States and the Northeast. These two western regions contain 50 per cent of the entire stand of saw timber left in the United States, and cut 10,355 million feet of lumber annually, or 31 per cent of the entire cut of the country. From 1915 to 1922, the lumber production of these regions increased 56 per cent, while the total cut in the rest of the country decreased over 30 per cent. Their 60,000,000 acres of forest land is more than the entire forest area of the Middle Atlantic and New England States from Maryland north. Under intensive forest management the three States of Washington, Oregon, and California should produce together an annual growth of 18,000,000,000 board feet, or over 25 per cent of that possible in the entire United States.

At the present time fire is the greatest single factor retarding the successful practice of forestry on the Pacific coast. Thousands of acres of mature timber are destroyed annually; but, what is much more harmful from the standpoint of our future timber supply, a much larger area of cut-over and restocking lands is being burned. It is essential that better methods of forest-fire control and suppression be perfected. We need more adequate knowledge of the climatic conditions which create dangerous fire hazards and the means of predicting their occurrence. Already a start has been made upon such studies, but much additional information is needed before remedial measures can be definitely prescribed.

Close to 3,000,000 acres in the three Pacific Coast States will require reforestation to make them productive. They will produce heavy stands of timber in 50 years' time. Better methods of forest planting, including the technique of nursery practice for our many species, sites, and forest types, must be developed. Again, agriculture in much of the region is largely dependent upon an abundant water supply for irrigation. In many sections the conservation of water supply and the prevention of erosion through intensive forest management and tree planting are necessary.

No industry can maintain itself without fundamental research, and this applies as much to lumbering as to agriculture or mining. In the older countries of Europe forest research has been under way for

scores of years and has made possible the present productiveness of their forests. Similar research work in this country is a necessity, and no time should be lost in getting it started in every important forest region. When the forest experiment stations have been built up to the size that the regions in which they are located justify they will return their cost in the future production of timber supplies manyfold. The widespread recognition of the necessity for research work through the medium of such stations shows that the country is alive to the importance of growing the timber crops necessary to meet our many and varied requirements.

### FOREST PRODUCTS INVESTIGATIONS—FOREST PRODUCTS LABORATORY.

The Forest Service has devoted much attention to the problem of finding raw material for pulp and paper. If existing conditions continue, no other fibrous material can replace wood to any great extent in paper manufacture. This conclusion has been reached after the investigation of many of the most promising substitutes, notably waste from plant crops. The main effort of the Forest Service is therefore being directed to adapting pulping processes to more kinds of wood. Only five or six out of a hundred or more commercial timbers in the United States now find extensive use in pulp and paper making. Spruce, fir, and hemlock constitute 78 per cent of all the pulpwood now consumed, and relatively small supplies of these woods are left within reach of the existing pulp mills in the Northeastern and Lake States.

Forest Products Laboratory experiments with about 90 of the little-used species have shown that a number of them can be pulped satisfactorily. The discovery made two years ago that the pines of the Southern States could be made into high grades of white paper without radical changes in mill practice has already been adopted commercially to some extent, releasing corresponding quantities of spruce for newsprint. The same series of pulping trials helped to attract the attention of pulp mills in the Lake States to jack pine by showing the possibilities of this wood as a substitute for hemlock, at present the chief source of sulphite pulp in this region. The pulping of jack pine has also been accomplished on a laboratory scale by semikraft process, which produces a pulp suitable for the manufacture of high-grade container board. The same process is adaptable to other species and offers possibilities in utilizing lumber mill waste, especially from long-fibered resinous woods, including southern pine and possibly Douglas fir.

An enlargement of the raw material for newsprint manufacture, a critical problem now faced by the United States, is foreseen in other experiments under way at the laboratory. It was found that by a certain mild chemical treatment wood could be pulped with a yield as high as 80 or 90 per cent—double that heretofore obtained by any chemical pulping process—and that the product could be made directly, without bleaching, into a paper similar to newsprint. Hardwoods in particular respond favorably to this treatment, indicating that it may become feasible to manufacture newsprint from woods very different in character from the few now employed in the ground-wood process. The pulping is accomplished without the excessive power required to produce ground-wood pulp. If this

process can be perfected and used commercially, it will greatly extend the life of pulp mills where they now exist and will aid materially in the establishment of the industry in new regions.

Research has recently produced the long-sought cheap preservative to spray on ground-wood pulp to prevent its decay during storage. Infection of pulp by fungi entails a triple loss—the total loss of pulp that is too badly decayed to use, the cost of sorting out this pulp, and the reduction in yield and quality of paper through the use of partly decayed material. Such losses amount to $6,000,000 annually at ground-wood mills. After two years of experimenting with various antiseptics, the laboratory provided the industry with several preservatives that were considered economical enough to use, and very recently found, in a mixture of cymene and naphthalene, a preservative much cheaper than any tried before. This mixture sprayed on ground-wood pulp stored in a damp fungous pit kept it fresh and clean for 10 months, while untreated pulp was rendered useless. The cost of the treatment is less than 50 cents a ton. Some mills are now spending as much as $2.75 a ton simply to sort out decayed from sound pulp.

For some time the Forest Products Laboratory has been collecting data necessary to the formulation of universal grading rules for lumber. In May, 1922, a general meeting of manufacturers and other interested groups was held in Washington under the auspices of the Department of Commerce to discuss lumber standardization. Various groups of manufacturers, wholesalers, retailers, and consumers have organized themselves, with the assistance of the Departments of Commerce and Agriculture, to prosecute the standardization of lumber grades and specifications to its ultimate conclusion.

In the meantime the Forest Products Laboratory had made a nation-wide survey of the conditions in lumber manufacture, distribution, and utilization, so that when representatives of the various lumber associations met in Madison, Wis., in July, 1922, it was able to present basic grading rules for softwood yard lumber and structural timbers. These rules were accepted practically in their entirety by the committee and also by an assembly of all interested in softwood lumber standardization held later in Chicago. A central lumber standards committee was appointed by this assembly, to act as a steering committee for lumber standardization activities and to induce the acceptance of the standards agreed upon by manufacturers and consumers.

The laboratory's nine basic grades for yard lumber unify the two dozen sets of grading rules of various lumber manufacturers' associations and the diverse specifications of wholesalers, retailers, consuming factories, railroads, departments of the Federal Government, States, and cities. The basic grading rules harmonize lumber manufactured in the various regions from the same or different species of wood into grades of equal quality intended for the same general purpose. Standard rules have also been developed covering the nomenclature of yard lumber, sizes for its principal forms (such as boards, flooring, drop siding, and finishing), and the grades for each of these forms.

The basic rules formulated by the laboratory for grading structural timbers cover all species that are used for structural purposes.

They are based on the factors affecting the strength of timbers, as determined by exhaustive tests, and are the only grades in existence to which accurate working stresses can be applied. Structural timbers have always been selected on the reputation of a species for strength, widely different working stresses being given to the same species in various building codes, usually without any limitation as to grade or quality. The result was sometimes dangerous—more often wasteful—construction. In most cases the new working stresses permit the use of smaller timbers, or fewer timbers, and so make possible the saving of much material.

In the latter part of 1922 the laboratory initiated studies of the grading of hardwood lumber and softwood factory lumber. When these are completed the four principal phases of lumber standardization will have been covered. Producers, distributers, and consumers of lumber can well afford to depart from past practices to the extent necessary to adopt this constructive and urgently needed improvement in the lumber trade.

Two years ago, with the general support of wood producing and consuming interests, the laboratory set out to ascertain the dimension stock requirements of all secondary wood-using industries to determine the most economical method of converting the log directly into the sizes required by these industries, to save waste through more extensive manufacture of small, clear pieces, should that prove possible, and to standardize and stabilize small dimension requirements. A year was devoted to determining the requirements of the chair industry, embracing 165 factories in all parts of the country. Some of the findings were: (1) The chair industry now uses about 16 per cent of its total wood requirements in the form of small dimension stock, but might use 78 per cent; (2) producing small dimension stock from lumber at the chair factory requires an average of 50 per cent more raw material than is used, and the final dimension cuttings cost one and one-half or two times the market price of the lumber delivered at the factory; and (3) one-third of the freight bill is on material wasted at the factory in the cutting-up process.

Subsequent studies of the dimension-stock requirements of the wood-turning, automobile, and general furniture industries, though not yet completed, point to the same general conclusions. Many small sizes of lumber will be standard for several industries. A program of small-dimension stock production, marketing, and use in all industries is practicable and logical, and will constitute an important step in the solution of the wood-waste problems of the timberland owner, lumber manufacturer, and fabricator of wood. It should be profitable to all the interests concerned, and particularly should extend the life of our diminishing hardwood supply.

In kiln drying, a series of experimental runs conducted last fall in the Northwest disclosed how to dry Douglas fir common lumber. A type of kiln that gives promise of performing this difficult drying is a new internal-fan, rapid-circulation kiln developed at the laboratory. Through the cooperation of the West Coast Lumbermen's Association, a commercial kiln located in the Douglas fir region was turned over to the Forest Service representatives, who remodeled it and conducted demonstration runs for three months. At the end of this time they had worked out a practical method of

drying common lumber, benefiting 40 per cent of the Douglas fir cut. A similar investigation on a larger scale was started in cooperation with the Southern Pine Association, where the annual losses due to improper drying of southern pine aggregate $10,000,000 annually. The practices of southern pine manufacturers in five States were surveyed and drying experiments conducted which showed how to eliminate most of their losses without additional expense.

The laboratory is continually bringing to light sources of waste and loss in the use of wood. In one sense practically all forest-products investigations are designed to reduce waste. Yet accurate statistics have been collected as to the extent of only a few of these losses. For preliminary research on the technical phases of a problem, it has been sufficient in most cases to know that the wastes were there and were of considerable proportions. One of the more recent undertakings of the laboratory is a more exact measurement of the wastes encountered in all of its field and factory studies and an assembling of this statistical information with the object of presenting a more graphic, comprehensive, and convincing picture of the present inefficiency in wood utilization. Such figures will make it possible to point out to the industries many losses that can be eliminated without further technical research, to determine more precisely the point to which refinement in factory processes may profitably be carried, and to lay out more certainly the future course of research in forest products. Waste in part unavoidable, but in part preventable, now amounts according to the best data available to about 41 per cent of the total volume of timber cut from the forests. The reduction of this waste is as essential a part of forest conservation as the prevention of forest fires or the growing of timber crops.

### INVESTIGATIONS IN FOREST ECONOMICS.

The problems of timber supply and forest-land use in the United States are at bottom economic problems. One of the primary requisites of the present situation is detailed and accurate facts on present and future timber supplies and consumption, on forest-land use in relation to agriculture, on timber and forest-land taxation, on the transportation of forest products, on timber values, and on the prices of lumber and other forest products.

Enough is now known about many of these questions to make clear the broad lines along which action must be taken, but the public, as well as individual industries, is handicapped by the lack of specific information. The pulp and paper situation is a case in point. General information is available, but the detailed facts on pulpwood supplies in specified States and regions are so meager that it is exceedingly difficult for the Forest Service to give the industry satisfactory assistance in planning for its future.

One of the most important of these economic questions concerns the kind, quality, and distribution of existing timber supplies and their availability for various purposes. Exact knowledge is also needed on the present requirements of individual industries as to the amount and quality of timber. Such information will give permanency and stability to industries and safeguard the public against disastrous fluctuations and shifts.

A second important question concerns the area, location, and distribution of forest lands, their relation to agriculture, and how our productive land should be divided between agricultural and forest crops. The most economic and profitable use of land is the foundation both of agriculture and forestry.

For the guidance of private owners as well as public agencies authentic data are needed on lumber values and the costs and prices of a wide range of forest products. Stumpage values afford one of the best guides for the private owner in determining whether he can grow timber profitably in various parts of the country. He should have access to information showing the past history and trend of timber values and their bearing upon the returns to be expected from crops now being started. The cost of growing timber and the prices of its manufactured products have an equally important use in encouraging reforestation where it may soundly be undertaken.

As in agriculture, transportation is a factor of fundamental importance in the whole question of timber growing. Transportation costs from the present sources of supply may be the decisive factor in deciding whether timber can be grown economically in any region. This question in its relation to timber supply and forest-land use has been studied but little and is only partially understood. Public as well as industrial welfare demands much more complete and accurate information than is now available.

Timber and forest land taxation is another factor of fundamental importance in private timber growing. The substitution of sound and stable methods of taxation for the common haphazard and unstable system of ad valorem land taxes will remove one of the chief obstacles to private forestry. While subject to State laws alone, research and leadership in the solution of forest taxation should be provided by the Federal Government.

The Forest Service now has a limited amount of work under way on several of these lines. It has been possible to make some study of the taxation question and to attempt the formulation of a timber and forest land-tax plan which will make timber growing feasible and at the same time meet the need of local communities for current revenue. A publication covering the information already secured is now in preparation. A preliminary study is being made of the transportation question with particular reference to lumber. A relatively small amount of data on stumpage values has been collected from time to time, and these also will be made available as soon as their character warrants. An investigation of the economic effects of forest fires and forest-land devastation in certain States has been under way for the past two years. An article in the department Yearbook for 1922, entitled "Timber: Mine or Crop?" prepared during the past year, is a summary of the more important data now available in the Forest Service bearing upon the economic problems of timber supply and forest-land use.

### RANGE INVESTIGATIONS.

As a matter of business administration, it is quite as essential that the forage resources of the national forests be maintained at their maximum as that the timber resources be so handled. Each

is a national resource vital to large agricultural and industrial interests. The purpose of the grazing studies work is to learn the fundamental principles affecting the improvement and utilization of the ranges and to introduce better practical methods of use.

Fundamental range investigations require thorough study for a number of years in specific areas where all of the controlling factors can be closely determined. In recent years the Forest Service has conducted this class of work largely at the Great Basin Experiment Station in Utah and the Jornada and Santa Rita Range Reserves in New Mexico and Arizona.

Some of the important results of range investigations are:

(1) Systems of range management, especially deferred and rotation grazing, have been developed which maintain the forage resource and increase its carrying capacity.

(2) Studies of artificial reseeding have made the improvement of range areas possible where conditions are favorable to this intensive method.

(3) The determination of the proper seasons for grazing various types of forage has prevented too early grazing, which decreased the stand and caused weakening and losses of livestock.

(4) The open herding and bedding-out system of handling sheep is now in application on over 65 per cent of the national forest ranges and on many private holdings, with a resultant increase of from 15 to 20 per cent in the carrying capacity of the range.

(5) Practical methods have been determined for eradicating tall larkspur, water hemlock, death camas, and other poisonous plants. The eradication of tall larkspur on a number of selected areas by the Forest Service in cooperation with stockmen, at a total expenditure of less than $38,000, has resulted in a saving of over $65,000 in the annual loss of cattle.

(6) The most practical and efficient ways of developing water under the varying conditions of the Southwest, where adequate water on ranges is so important, have been carefully worked out.

(7) A practical system of cattle management for the semidesert ranges of the Southwest has been developed which permits satisfactory production and helps prevent excessive losses during drought periods.

In the 11 far Western States there are approximately 110,000,000 acres of grazing land within the national forests, nearly 175,000,000 acres of unappropriated and unreserved public domain suitable for grazing purposes, and over 350,000,000 acres of private and State lands and other Federal reservations which are capable of being grazed. Approximately 32 per cent of the sheep and 18 per cent of the cattle, exclusive of lambs and calves, in the 11 western range States are grazed upon national forest ranges during a part of the year. These ranges have since 1907 increased in productivity about 25 per cent, while the major part of the unreserved public ranges have been deteriorating until now they probably have not over half their original productivity. The increase in productiveness of the forest ranges has been due primarily to the fact that the range investigations have afforded a scientific basis for the management and utilization of the grazing resources and represents an increase of over $400,000 per annum in grazing receipts.

The open-herding and bedding-out system, together with other phases of better sheep management, has increased the weight of lambs coming from national forest ranges about 5 pounds each, which at a very conservative estimate means 10,000,000 pounds more on lambs each year. At a valuation of 7 cents per pound this amounts to approximately $700,000 each year clear gain to the lamb producers. An increase of from three to four million pounds of wool has resulted from these improved methods. The application of improved methods in handling cattle on national forest ranges has increased the number and weight of cattle grazing thereon and the number of calves produced, and has decreased the losses to such an extent that compared with 1907, when the range investigations were started, the increased production of beef from national forest ranges has been conservatively estimated at 40,000,000 pounds. The extension of improved management should increase these figures materially.

These results on the national forests stand out in contrast to those being obtained on the open public domain, where lack of regulation prevents the application of satisfactory management. Regulation of the unreserved public domain would make possible a better control of the spring, fall, and winter ranges and would remove one of the greatest handicaps to stability in the livestock industry.

The range investigations have been made with an annual expenditure never exceeding $35,000. It has been impossible to study all the problems of range management in the West. Vegetative conditions are so different and the controlling factors of climate, growth, and range management so varied that adequately to cover the situation and needs will require additional investigations of the problems peculiar to ranges at different elevations and to individual regions. This work deserves extension at the earliest date possible.

### GRAZING RECONNAISSANCE.

Grazing reconnaissance is being extended as rapidly as funds will allow. During the year a total of 1,970,000 acres on the Beaverhead, Deerlodge, Helena, Montezuma, Santa Fe, Fillmore, Caribou, Minidoka, Modoc, and Shasta National Forests were covered by grazing specialists and management plans developed. This makes a total of over 20,000,000 acres of national forest lands on which range reconnaissance has been conducted. The value of this work lies in the more specific knowledge obtained of the grazing resources.

### EXTENDING TECHNICAL GRAZING KNOWLEDGE.

Special efforts have been put forth in recent years to train a corps of grazing specialists within the national forest organization and to instill a better understanding of range management in all forest officers and grazing permittees. Every new technical grazing man is given a course of practical training under the guidance of experienced men already in the organization. Considering the importance of the livestock industry dependent upon the national forests and its value to the West, there is serious need of enlarging the technical grazing personnel of the service.

COORDINATION OF GRAZING STUDIES WORK.

The correlation of all grazing studies work in the western range States has been strongly emphasized. Plans for cooperative investigations by the Forest Service and a number of State agricultural experiment stations have been worked out. A cooperative study of the spring, fall, and winter sheep ranges jointly by the Bureau of Animal Industry and the Forest Service has been started at the United States sheep experiment station of the former bureau at Dubois, Idaho. The Forest Service has assisted in the range extension program which the Department of Agriculture is developing in cooperation with the Western States Extension Service. This program should develop closer coordination of the extension work with that of the Forest Service in the study and application of improved range management.

## INFORMATIONAL AND EDUCATIONAL ACTIVITIES.

The forest problem of the United States is in an important sense a problem of public education. The private owners, especially the great number of small owners, should know what prospect of profit timber growing holds out, how to market salable material to the best advantage, how to cut so as to secure regrowth of the right kind, and how to restore run-down forest and idle land to good productive condition. The introduction of new practices in land use must overcome a tremendous inertia due to unfamiliarity and hesitation to embark on a course not fully charted by custom and experience. Wood-using industries and consumers alike need to be educated in the most economical and advantageous use of wood. The general public needs thorough education in the prevention of forest fires of a kind that will change ingrained habits—no light or simple task. The public should also have an intelligent grasp of the reasons why forest conservation is necessary from the standpoint of local and national welfare, how it is practiced, and what part the public should take in promoting it. The educational task in forestry is of an importance fully equal to any that is presented by the whole great problem.

The Forest Service is endeavoring to carry the responsibilities resting upon it in this field to the extent that available resources permit. As public interest in forestry grows the openings multiply. There is particular need for more vigorous and better organized effort in cooperation with local agencies of various kinds to aid State forestry movements and for extension work to bring forestry into much wider practice through demonstration methods that can be observed and copied locally.

Among the means employed may be specified publicity through the departmental press service, readable popular publications, talks and illustrated lectures, the circulation of sets of lantern slides and lecture outlines and of a few small traveling exhibits, chiefly for use by teachers, the making of exhibits and educational motion pictures under general departmental plans, and the building up of collections of high-grade illustrative material—photographs, lantern slides, etc. At the Forest Products Laboratory much attention is given to extension work in the industrial uses of wood through short educational

courses conducted at the laboratory and in other ways. A special effort is made to give help to teachers in introducing more forestry into their educational work, but the opportunities along this line are enormously beyond the equipment of the service.

A large obligation rests upon the service to educate the public in forest protection, since two of the largest expenditures of the service are to prevent forest fires on the national forests and, in cooperation with States, on private and State forest lands. While organized systems for the suppression of fire will always have to be maintained, a major part of the task of bringing about adequate protection is educational; and merely organizing to put out fires without endeavoring to obtain the cordial cooperation of the public for their prevention and control would be an undertaking of hopeless futility.

The field force of the Forest Service has thrown itself into the task of public education in forestry with ardor, intelligence, and striking success. To them, of course, the matter comes home in a most practical way; without the interest of the public in their work, a fair understanding of its direct value, and a disposition to cooperate, the task of successful administration and protection would be well-nigh impossible. Down to the forest rangers, and by no means least on the part of the rangers, the forest force has become a powerful agency for spreading the gospel of protection among the public and for making known the nature and purposes of the public enterprise in forestry. The results have been of very great value. Use of the national forests is increasing by leaps and bounds, but the fire hazard does not correspondingly increase—if anything, it gives evidence of growing less.

The interest of the forest personnel in fire prevention through education has reached the point where a demand is coming from the men for material that they can use in talks before schools, small meetings, commercial and civic bodies, and the like. Lantern and motion-picture equipment is being asked for from the field at a rate decidedly beyond the capacity of the service to supply. Indeed, there are almost unlimited possibilities for the use of educational material, through all sorts of agencies, if an adequate supply were available. The educational work of the service should be much more amply provided for than it ever has been. It is capable of making very great returns on the outlay.

# REPORT OF THE CHEMIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
*Washington, D. C., September 14, 1923.*

SIR: I beg to submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1923, and recommend that it be printed in the usual manner.

Respectfully,

W. G. CAMPBELL,
*Acting Chief.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## INTRODUCTION.

The Bureau of Chemistry is authorized in the appropriation act for the Department of Agriculture to conduct investigations relating to the application of chemistry to agriculture; to make biological investigations of food and drug products, including the physiological effects of such products on the human organism; to develop methods for the manufacture of table sirup and sugar; to investigate the composition, action, and application of insecticides and fungicides; to develop methods for the prevention of plant-dust explosions and fires in cotton gins and cotton-oil mills; to improve methods for dehydrating fruits and vegetables; to investigate the grading, weighing, handling, transportation, and uses of naval stores, and to demonstrate improved processes of preparing naval stores; to conduct experiments on the utilization, for coloring, medicinal, and technical purposes, of raw materials grown or produced in the United States; to collaborate with other departments of the Government in chemical investigations; to enforce the act to prevent the importation of impure and unwholesome tea; and to enforce the food and drugs act, commonly called the pure food law.

The purpose of this report is to outline briefly the specific work conducted and the important results accomplished during the fiscal year ended June 30, 1923.

## AGRICULTURAL CHEMICAL INVESTIGATIONS.

Basic research work in agricultural chemistry, including the application of the results to agriculture and to the development of new or improved methods for the manufacture of products made from farm crops, was carried on during the year under one general authorization and under five specific authorizations.

### WORK UNDER GENERAL AUTHORIZATION.

Under a general authorization for investigations relating to the application of chemistry to agriculture, work was done on crop chemistry, on a study of the odorous principles of the cotton plant, on proteins, on vegetable oils, on citrus fruits, on cassina, on tanning and leather, on the waterproofing, mildewproofing, and fireproofing of fabrics, on the utilization of cull and surplus sweet potatoes, on the production of gas from straw, and on methods of analysis of agricultural products.

### CROP CHEMISTRY.

Research in the chemistry of plant constituents has yielded knowledge of tremendous value to agriculture. Upon this knowledge of fats, sugars, starches, proteins, etc., great industries, which have enhanced the value of the raw products of the farm, have been developed. A knowledge of the relation of the mineral matter in the soil and in the plant to the value of the plant as food is of fundamental importance. During the year a preliminary study was made of the migration of the mineral constituents from the stalks to the heads of wheat with the advancement of the growing season. Work was done on a study of the lime requirement of plants and on the analysis of plant materials. A study of wheat seedlings undertaken to determine the effect of initial hydrogen-ion concentration of the medium on the rate of absorption of phosphoric acid and potassium is being continued.

Although much of the research work heretofore undertaken on crop production has had for its object the laudable purpose of greater yield per unit, nutritive quality is of equal importance with quantity of yield. Hence the chemist seeks to learn whether or not there is danger of producing quantity at the serious expense of nutritive quality. Work on this subject is now under way.

### ODOROUS PRINCIPLES OF THE COTTON PLANT.

A study of the odorous principles of the cotton plant, which are presumed to attract the boll weevil, was undertaken in cooperation with the Bureau of Entomology. If it should be found possible to identify the odorous compounds and obtain them from some other source in sufficient quantities for practical use, a method might be devised for the eradication of the boll weevil which is causing widespread destruction of cotton. The preliminary work is being conducted at Tallulah, La., while the more detailed operations will be carried on in the laboratory at Washington.

### PROTEINS.

The most costly per unit as well as the most important constituent of our foods is the nitrogenous matter. Animals are wholly dependent, either directly or indirectly, upon nitrogenous products synthesized by plants. Recent researches have shown that vegetable proteins vary in composition. Some of the amino acids which constitute the various proteins are now known to be essential to animal

growth and development. Some of the vegetable proteins are deficient in these essential amino acids. Therefore a knowledge of the constituents of the vegetable proteins is essential to a knowledge of nutritional requirements and the value of our food materials.

During the year the physical and chemical properties of various proteins were determined. The cystine and tryptophane content of a large number of proteins is being determined. A study on the nutritive deficiency of arachin, which is the chief protein of the peanut, is in progress. Peanut meal, when fed to animals as the sole source of protein, has an unusually high degree of efficiency.

A study of the proteins of wheat bran is in progress. When this work was begun practically nothing was known regarding the chemical or physical properties of the proteins of wheat bran, notwithstanding the fact that 22 per cent of the total protein of the wheat kernel is in the bran. Bran has long been regarded by practical feeders of farm animals as having high nutritive value, and it has been considered that the proteins of wheat bran are superior in nutritive quality to those of the endosperm. Nearly 66 per cent of the total protein in the bran has been isolated and identified. The chemical properties and composition of these proteins have been studied. A study of the nutritive value of the proteins of the lentil has been made.

A critical study of the amino acids in the hydrolysis products of glycinin, the chief protein of the soy bean, is being continued. Special attention is being paid to the development and improvement in the methods and technique involved in the quantitative determination of amino acids. There is under way a study of the proteins of cacao beans and also a chemical study of the proteins of cottonseed. Analyses of several preparations of the cottonseed globulin have been made. In a study of the proteins of the navy bean, a hitherto unknown globulin, which has been called conphaseolin, has been isolated. The chemical properties of this globulin have been determined and analyses to determine the percentages of the nutritionally essential amino acids have been made.

A paper on "The nutritive value of mixtures of proteins from corn and various concentrates," in the Journal of Agricultural Research, shows that the proteins of peanut meal, soy-bean meal, coconut press cake, and tomato-seed press cake contain, in sufficient quantity to supplement satisfactorily the corn proteins, the amino acids which are lacking in corn. The various proportions of concentrate to corn which were used and found satisfactory for the normal growth and development of animals are reported.

### VEGETABLE OILS.

In nutrition the fats and oils are second in importance only to the proteins. Through the application of chemistry to the refining of crude products and to the so-called hardening (hydrogenation) of vegetable fats there has been a tremendous development in the utilization of vegetable oils—a profitable development for the farmer and planter, which has added millions to our national wealth. Such research work is of no less importance to the consuming public in making available a nutritious and cheap food. This development has been dependent almost wholly upon agricultural chemical research.

During the last year an investigation was made of the composition of the free fatty acids and the nonglyceride constituents of crude cottonseed oil. Results of work on the chemical composition of soy-bean oil and of sunflower-seed oil were published during the year. An extensive research on the composition of the oil from chufa tubers was completed. A paper on lard and its relation to vegetable oils was published.

### CITRUS FRUITS.

Work on the development of methods for the profitable utilization of cull and surplus oranges and lemons was continued. How this work has aided in the establishment of industries manufacturing useful products from oranges and lemons, thus providing a profitable outlet for fruit that would otherwise go to waste, has been covered in the reports for previous years.

During the last fiscal year the work was directed to the perfection of the method for the commercial production of pectin from waste orange and lemon peel. Pectins produced by various methods have been standardized as to their jellying power, and work has been done on the production of jellies of different consistency. Attention was given to the preparation of marmalades and jellies from dehydrated oranges. The effect of different temperatures and the length of time of dehydration upon the pectin content has been studied. New methods for the preparation of marmalade and orange butter have been evolved through the work on the production of pectin.

Preliminary work on the analyses of California orange and lemon oils has been undertaken.

### CASSINA.

Cassina (*Ilex vomitoria*), a shrub-like plant which grows wild in profusion in the South Atlantic and Gulf Coast States, is believed to have great economic possibilities. Its leaves when properly cured resemble yerba maté or Paraguayan tea, millions of pounds of which are consumed annually in South American countries, especially Argentine and Chile. The development of an export and domestic trade in the cured cassina has inviting possibilities.

The technological processes for utilizing cassina have been developed to a high degree of efficiency, the process of manufacturing black cassina having been much improved during the past year. It has been demonstrated that it is practical to manufacture on a commercial scale the cured leaves of the cassina from which a delightful beverage, flavoring sirup, and concentrated extract can be made. This extract has been used as a flavor in the manufacture of ice cream with most promising results.

The development of a market for new foods and drinks is always a slow process. The question of whether a profitable domestic cassina industry will be established now depends upon finding an adequate market for the cassina products. The indications are that such a market may be developed in time. The foreign market for maté with which it will compete is already established. It would seem, therefore, that all that can be done by a Government agency has been accomplished. It now remains for private concerns to undertake the development of what may become a great national industry.

### TANNING AND LEATHER.

The production of leather is of more interest to agriculture than to any other industry, for not only does agriculture produce the raw products of leather, the hides and the tanning materials, but it is by far the largest consumer of the finished product. The chemistry and the technology of leather making are therefore directly related to profitable agriculture.

The results of experiments to determine the relative wearing qualities of shoes made from different kinds of leather tanned by various processes are given in Department Bulletin 1168, Wearing Qualities of Shoe Leathers. The outstanding indications from this investigation are: (*1*) The superior pliability of retanned chrome and chrome-tanned upper leathers; (*2*) the features that are objectionable in fiber soles and the long wear of those that did not develop such features; (*3*) the greater serviceability of rolled vegetable-tanned sole leathers, as compared with unrolled leather of the same thickness; (*4*) the strikingly longer wear of chrome-tanned sole leathers, especially of the unwaxed chrome-tanned leather.

In addition to the wear data, extensive analytical data showing the composition of the original leathers and of parts of the worn soles from these leathers are reported. These data involved more than 1,500 determinations. The data obtained in this investigation will be of value to buyers of shoes, especially to the large buyers like the War Department, by indicating specifications for the most suitable shoes, to manufacturers by indicating the most efficient leather for making longer wearing shoes, and to tanners in aiding them to improve processes for making more durable leather.

Experiments were conducted to reduce deterioration in bookbinding leathers. Much of the bookbinding leather used to-day is of inferior quality. Attention was also given to bookbinding cloth to prevent rapid fading and destruction by roaches. Fading is a matter of some importance in binding yearly volumes which should match in color from year to year. Attempts were made to devise a roach-repellent treatment which might be applied at the bindery.

Detailed directions for making bark-tanned sole and harness leather, chrome-tanned leather, and alum-tanned lace leather on a small scale are given in Farmers' Bulletin 1334, Home Tanning of Leather and Small Fur Skins.

Investigations on raw materials for leather manufacture were continued. Attention was also given to the recovery and utilization of tannery and leather wastes.

### WATERPROOFING, MILDEWPROOFING, AND FIREPROOFING FARM FABRICS.

The waterproofing, mildewproofing, and fireproofing of fabrics for farm and other uses are of importance because of the growing use of canvas as a protection against the weather. The introduction of long-distance hauling by truck has greatly increased the need for durable, water-resisting covers. Great quantities are used for wagon covers and for the protection of grain and hay in the cock or stack. Contractors and builders need dependable canvas to protect machinery and materials. The Army and Navy need a great deal of canvas, and the summer camper is a large consumer. Often

the serviceability of canvas may be doubled by proper treatment to protect it against moisture and sun.

The result of the investigation on the effects of waterproofing materials and outdoor exposure upon the tensile strength of cotton yarn showed that after exposure to the weather for one year the treated yarn was in most cases stronger than the untreated yarn after exposure. Exposure tests on cotton duck given the same and similar treatments indicated that the results on yarns are not strictly applicable to the woven fabric, since the treated canvas after exposure is usually weaker than the untreated canvas after exposure. An important investigation was completed on the effects of materials used in waterproofing and of outdoor exposure to the weather on the tensile strength and water resistance of canvas. The conclusions drawn from the investigation are that the addition of certain mineral pigments to waterproofing preparations is beneficial, since they reduce the weakening effect of solar light and heat without reducing the water resistance.

Investigations in cooperation with the Connecticut Agricultural Experiment Station and the Connecticut Valley Tobacco Improvement Association are now in progress to develop methods for treating tobacco shade cloth so that its serviceability may be materially increased. It is believed that the final results of this investigation, which is being conducted both in the field and in the laboratory, will be useful in increasing materially the life of tobacco shade cloth.

### UTILIZATION OF CULL AND SURPLUS SWEET POTATOES.

Great areas in the Southern States are peculiarly adapted to the growing of sweet potatoes which, if produced with a reasonable assurance of profit, would serve a useful purpose in developing diversified farming in the South. The possibility of increasing the profitable production of sweet potatoes depends upon the development of a demand for sweet-potato products. Thus far it has been impossible to develop a market to an extent commensurate with the production possibilities. The technology of converting sweet potatoes into salable food products is a problem to which the bureau has given much thought and energy.

A laboratory investigation has shown that, upon cooking, sweet potatoes change from a starchy into a saccharine foodstuff which is largely maltose sugar, one of the most nutritious and digestible of the carbohydrates. It was found that the diastatic power of dried sweet-potato tissue is three or four times that of the best distillers' malt. This suggests the possibility of the development of an industry for the production of sweet-potato flour to be used because of its high diastatic power in bread making and in other ways.

Experimental work showed that the sweet-potato diastase has three striking properties: (*1*) It has less liquefying power than malt diastase; (*2*) it does not attack the complexes in the starch molecule as uniformly as does malt diastase; (*3*) it works at a higher temperature than malt diastase. Work on the technical significance of these properties is now under way.

The results of experimental work on the manufacture of sirup from sweet potatoes are published in Department Bulletin 1158, Production of Sirup from Sweet Potatoes.

PRODUCTION OF GAS FROM STRAW.

The tests at Arlington on the production of gas from straw and similar waste materials have been completed and the results of the entire experimental work have been prepared for publication as a department bulletin. The tests showed that gas produced from straw may be used successfully for lighting and heating and as a motor fuel, but indicated that the destructive distillation of straw and similar material for the production of gas on the farm is not practicable. The cost of the gas is practically prohibitive and much difficulty is encountered in the operation of the plant.

Although the general results of these tests may be considered negative, they have the very positive value of meeting the active demand for information on this subject.

METHODS OF ANALYSIS.

The development of methods of chemical analysis is one of the important functions of the Bureau of Chemistry. This work is done in cooperation with the Association of Official Agricultural Chemists and other scientific associations. The value of having uniform methods of analysis, so that results obtained by different chemists working on the same products may be comparable, is apparent. While the immediate results of this work are of interest only to chemists, the ultimate results are reflected in an improved agriculture and in the development or improvement of industrial processes for the utilization of agricultural products.

WORK UNDER SPECIFIC AUTHORIZATIONS.

Investigational and experimental work on table sirup and beet and cane sugar, insecticides and fungicides, plant-dust explosions and cotton-gin fires, dehydration of fruits and vegetables, and rosin and turpentine was conducted under separate authorizations.

MANUFACTURE OF SIRUP AND SUGAR.

The economic conditions that make imperative the need for chemical and technological work on the development of improved methods for the manufacture of sirup and sugar presented in last year's report should be considered in connection with the following statement regarding the continuation of the work.

*Improvement in manufacture and handling of cane sirup.*—The work on production of cane sirup of uniform quality outlined in the 1922 annual report was actively carried forward in cooperation with State farm bureau federations, particularly in Texas. A central blending and canning plant with a daily maximum capacity of 5,000 gallons, equivalent to 500,000 gallons for a 100 days' operating season, was designed by the bureau for the Texas Farm Bureau Ribbon Cane Growers Association. This plant was erected at Lufkin, Tex., at very moderate cost and was placed in operation during the season of 1922–23. A representative of the bureau was stationed at Lufkin to give advice on the technical operation of the plant.

A refining-in-transit freight rate was secured and cane sirup from various sections of eastern Texas was shipped by members of the association to the Lufkin plant where it was graded, mixed on a

sufficiently large scale to insure uniformity of grade, treated by the invertase process perfected by the bureau to prevent crystallization, canned, labeled, crated, and shipped to market. An improved system of commercial grading of sirup was devised.

Technically the process has proved to be an unqualified success and it has been operated at very moderate expense. Noncrystallizing sirup of high and uniform quality was produced from farm-made sirup of varying character. As a result of the working out of this chemical-technical problem, farmers producing cane sirup were able to consolidate their output on a sufficiently large scale and into such a uniform product as directly to interest brokers and wholesale grocers in its distribution in a systematic manner.

A study was made of the manner of production of cane sirup on the farms and directions showing how the quality of the product could be improved were distributed to producers. At the same time experiments were conducted for the purpose of improving the quality of low-grade sirup by various procedures, including treatment with decolorizing carbon. Promising results were obtained and investigations along this line will be continued. An investigation was also started for the purpose of working out all necessary details for the production of cane sirup on a larger scale in mills of increased capacity. It is believed that the development of the cane-sirup industry depends on larger scale operation and consequent reduction in costs, either by increasing the size of the unit mill or by the operation of cooperative blending and canning plants, taking advantage of a refining-in-transit freight rate.

The application of the invertase process for preventing crystallization or so-called sugaring of cane sirup was greatly extended for use at producing sirup mills during the year. Demonstrations of the process were made by representatives of the bureau in Georgia, Alabama, Mississippi, Louisiana, and Texas.

*Sorgo sirup.*—The situation with respect to the production and distribution of sorgo sirup, formerly known as sorghum sirup, is practically the same as that which is being corrected in the case of cane sirup. Approximately 40,000,000 gallons of this product is now manufactured annually in the United States by a large number of individuals, but on a relatively small scale in most cases. At the same time, sorgo sirup is an important product in the agricultural scheme of a large farming area. Sorgo sirup as produced by this large number of farmers varies greatly in quality and the producers are not able to furnish a sufficiently large volume of sirup of uniform quality to permit them to establish a stable market. Farm bureau federations in certain sorgo-growing States are planning to undertake cooperative marketing of sorgo sirup and have requested the bureau to work out the chemical and technological problems involved. Arrangements to this end have been made.

*Use of invertase in products other than cane sirup.*—As a by-product of the work on the use of invertase for preventing crystallization of cane sirup, and at practically no additional investigational expense, some important uses of this product in the confectionery industry have been developed and protected by public-service patents. These improvements make possible more rapid and continuous processes for producing candy of fondant-center type, thereby reducing time and expense of manufacture. Chocolate-coated fondant centers

of any desired degree of consistency, varying from completely liquefied centers of the cordial type to so-called slightly flowing centers, may be produced at very little expense. Invertase may also be used in further reduced quantities for the primary purpose of causing inversion of sucrose just sufficient to keep the centers moist for a greatly increased period, the drying out or aging of these types of candy being thereby much retarded.

*Cane-sugar industry.*—In continuation of the program outlined in last year's report, a systematic investigation of the refining value of raw sugar is now actively under way. Variations in the suitability of raw sugar for the production of standard granulated sugar may affect the returns to the plantation. Not only the particular process used in the mill for clarification of the juice, but also the variety of cane and various cultural conditions are apparently of great importance in this connection. The character of the soil appears to have an influence on the amount of inorganic constituents. Variations in the character of the impurities contained in raw sugar have in many cases caused great difficulty in refining and have consequently acted unfavorably to the interests of the planter. One of the principal troubles, difficult filtration of raw-sugar melts, is evidently of a colloidal nature.

Since the effect of the clarification processes used in the raw-sugar factory consists primarily in the elimination from the juice of colloidal material, it has been necessary first of all to devise means whereby the character and quantity of the colloidal matter present in the juice before and after clarification can be accurately determined. Means for doing this have not heretofore been available. The special methods and apparatus devised in the investigation of this problem make it possible for the first time to determine accurately the character and quantity, and eventually the exact origin, of the colloidal material originally present in the cane juice, that which remains after clarification, and that which is present in raw sugar. This work also makes possible a more exact determination of the value of various processes now in use for clarifying cane juice in both raw-sugar and white-sugar manufacture.

In further continuance of the work outlined last year, an investigation has been started for the purpose of determining sugar losses by inversion in different methods of manufacture. Very little accurate information on this important problem is available. Such data will be of value to domestic sugar technologists in helping them to select the most efficient and most economical method of manufacture. In order to prevent continued losses, there is urgent and immediate need for a determination of the fundamental conditions required to give efficient clarification of cane juice in connection with plantation white-sugar and raw-sugar manufacture and to reduce or eliminate losses caused by inversion of sugar. If the conditions most favorable for accomplishing these two objects do not prove to coincide entirely, it will be desirable to adopt a compromise procedure which will, on the whole, give the best results. Since the most favorable chemical condition for the clarification of the juice may vary decidedly with the quality of cane, it is necessary to consider fully this phase of the question in arriving at a solution.

During the past few years final or blackstrap molasses has commanded a very low price which is not at all commensurate with the

inherent value of the product from the standpoint of its composition. There is a distinct opportunity for securing from blackstrap molasses products of great value compared with the present low price of the molasses. Work directed toward a more profitable manner of utilizing blackstrap molasses has been actively under way during the past year and important progress has been made.

*Beet-sugar investigations.*—In furtherance of the work already under way, the investigations of the past year have been carried forward, with the object of obtaining more accurate knowledge of the objectionable organic nonsugar substances which are extracted from beets in the juice with sugar. This material varies in quantity, depending on the character of the beets, and is a primary factor in causing the sugar losses under investigation. The necessity for storing a large proportion of sugar beets after harvesting and before working the beets in the factory is predominantly associated with these sugar losses. There is a very great difference between the ease with which sugar can be extracted from unstored beets and the difficulty encountered in the case of stored and deteriorated beets. In addition, the total recovery of sugar from unstored beets is greater than that from stored beets. Furthermore, there are distinct indications that cultural conditions, such as type of soil and degree of maturity, predominantly determine the deterioration which sugar beets undergo in storage. As the net result is to reduce the value of sugar beets as an agricultural crop, the successful solution of this problem is of great economic importance.

Distinct progress has been made toward the solution of the problem. For this purpose it was necessary to devise and install equipment for reproducing on a small scale the factory operations employed in boiling and crystallizing beet liquors. Apparatus was also developed for more accurately determining the effect of the impurities in beet liquors on properties such as hydrogen-ion concentration, viscosity, solubility, and rate of crystallization of sucrose, and on the form and size of the sugar crystals.

As a by-product of the investigation as a whole, there was developed a much more accurate analytical method for the determination of sucrose, and incidentally raffinose, in beet products in connection with factory control of sugar recovery than has heretofore been available. This is most important in view of the fact that cost control of the entire processes of growing and handling beets and extracting sugar therefrom depends on an accurate knowledge of the quantity of sugar in the beets and the yield obtained. This method was tried out in actual practice by a representative of the bureau in one of the western beet-sugar factories during the season of 1922, and the results obtained permitted more accurate detection and estimation of sugar losses. The efficiency of the Steffen process now used in this country for the desugarization of beet molasses was more fully studied and the extent of known and unknown losses of sugar was more accurately determined.

### INSECTICIDE AND FUNGICIDE INVESTIGATIONS.

As crop production becomes intensified new biological problems arise in the attempt to maintain an equilibrium which will be of benefit and profit to man. Some of our most acute agricultural problems originate from insect depredations or from plant diseases

transmitted or stimulated by insects. The control of insect pests depends upon effective and cheap insecticides and fungicides. Research work on the chemistry of insecticides and fungicides therefore has tremendous economic significance. This is recognized by the bureau as one of its most important fields of activity, which is being developed and expanded as rapidly as possible.

A study is being made of foliage injury by arsenicals and other insecticides and fungicides in order to develop spray materials which, while acting in an efficient manner, may be applied to tender foliage without injury. Owing to the importance which calcium arsenate has assumed in the dusting of cotton for control of the cotton boll weevil, an extensive investigation of the physical and chemical properties upon which its effectiveness in a measure depends is being made. The field work conducted at Tallulah, La., during the year has resulted in two achievements of importance—the development of a quick test for detecting high water-soluble arsenic in commercial calcium arsenate, and the discovery that the dew on cotton plants contains relatively large quantities of plant exudate, which compounds, in the presence of moisture, decompose calcium arsenate, thus affording a possible explanation of many cases of unanticipated plant injury which have been observed in the dusting of cotton.

The demand for calcium arsenate for boll-weevil control has had the effect of greatly increasing the price of arsenic and arsenicals. This is now a serious matter for fruit growers and others using arsenic in some form for the control of insect pests, and it is likely to develop into a more serious one. Work is being actively prosecuted in the chemical technology of arsenical production for the purpose of discovering methods for lowering the cost of production. Some very suggestive results have already been obtained. During the year Department Bulletin 1115, Chemical Changes in Calcium Arsenate During Storage, was published.

An investigation to determine the effect of copper sprays in increasing the yield of potatoes and the effect of such sprays on the composition of potato tubers and to determine the absorption and distribution of copper in sprayed plants has been completed. The copper sprays were shown not only to increase the yield of potatoes but also to produce potato tubers having a higher percentage of solids; that is, more starch and nitrogenous compounds. The results of this study are given in Department Bulletin 1146, The Influence of Copper Sprays on the Yield and Composition of Irish Potato Tubers.

The relative toxicity of a number of arsenicals to several species of insects was determined, and the results were reported in Department Bulletin 1147, Chemical, Physical, and Insecticidal Properties of Arsenicals.

An investigation, in cooperation with the Bureau of Entomology, of the toxicity of a number of the active constituents of plants and synthesized organic compounds as contact insecticides was conducted. The results of this work are reported in Department Bulletin 1160, Studies on Contact Insecticides.

Research to develop a contact insecticide as a substitute for nicotine has resulted in the synthesizing of two new compounds, derivatives of pyridine, which are highly toxic to certain insects. Work with these compounds is being continued and the development of methods

for their economical production on a commercial scale is being studied.

An extensive investigation is being made of fumigants for treating insect-infested grain in storage and in transit, in order to find a substitute for carbon disulphide, the use of which has been prohibited by the railroad officials of the United States on account of the fire hazard. About 250 fumigants have been tested.

Fumigating food products with hydrocyanic acid gas for the destruction of insects is now very widely practiced. In order to determine whether or not they may be rendered unfit for human consumption, a great variety of such fumigated products have been analyzed and the quantity of hydrocyanic acid remaining in them under different conditions of treatment has been determined. This work is reported in Department Bulletin 1149, Absorption and Retention of Hydrocyanic Acid by Fumigated Food Products. The work is being continued and extended to include domestic and imported dried and preserved fruits, candy, nut meats, etc.

A detailed chemical and microscopical study of oil emulsions, used for insecticides, particularly emulsions of kerosene with sodium oleate, potassium stearate, and palmitate, has been completed, and the results are published in the Journal of the American Chemical Society, for July, 1923, under the title "Emulsions of mineral oil with soap and water: The interfacial film."

In cooperation with the Bureau of Entomology, a project for the control of flies infesting domestic animals was continued during the year. A preliminary report, entitled "Progress report of investigations relating to repellents, attractants, and larvicides for the screw-worm and other flies," was published in the Journal of Economic Entomology for April, 1923.

### PREVENTION OF PLANT-DUST EXPLOSIONS AND COTTON-GIN FIRES.

Investigations to determine the causes of dust explosions and the circumstances favorable to their origin are being made. Although the general scope of the investigations is confined to grain handling or milling operations, in some instances it has been possible to study dust explosions in other types of industries. As a result of the investigation of a large number of explosions, it may be definitely concluded that under certain conditions dust explosions can occur in any industrial plant or manufacturing establishment where combustible dust is created during the operating processes. The importance of this work is more fully realized when it is considered that over 21,000 establishments in the United States, manufacturing products with an annual value in excess of $6,000,000,000, are subject to the dust-explosion hazard.

Special studies are being made to determine the practical possibility of installing an effective dust-collecting system for the control of the explosive dust created during the handling and storing of grain in terminal grain elevators.

The investigations have been planned not only to study installations of dust-collecting and ventilating systems, but to ascertain the lower explosive limits of the industrial-plant dusts that have caused these explosions, and then to determine whether or not the present systems are adequate. This has necessitated the establishment of a dust explosion laboratory in the bureau, the function of which may

be conceived as being of a twofold nature, (*1*) to carry on a type of research work which industrial and agricultural industries, State safety commissions, insurance associations or individuals can not perform, on problems of a physical-chemical nature, for the prevention and control of dust explosions, with the development of the proper instruments and devices for this purpose, and (*2*) to render expert advice, after proper testing, on the explosion hazards of dusts and powdered materials submitted by the agencies mentioned.

Instruments to determine the quantity of dust in the air are being devised. Determinations of the percentage of combustible and noncombustible constituents of dusts are made.

The bureau cooperates with national and commercial organizations interested in the reduction of fire and explosion losses, such as the National Fire Protection Association, National Safety Council, National Board of Fire Underwriters, Underwriters' Laboratories, Chamber of Commerce of the United States, and State industrial and welfare commissions.

*Fires in cotton gins and cottonseed-oil mills.*—As a result of investigational and experimental work at cotton gins in the Southwest during the 1922 ginning season, an improved and simplified grounding system for the control of static electricity during ginning operations was devised. The results of this work were published in Department Circular 271, Grounding Cotton Gins to Prevent Fires. Negotiations for the complete recognition of the effectiveness of the grounding system recommended were undertaken with the State Insurance Commission of Texas and various companies underwriting cotton gins in that State. As a result it is expected that the insurance rates on gins in Texas will be further revised, provided the gins are adequately grounded. Such recognition has already been given in a number of Southeastern States.

Preliminary investigations relating to a study of fires in cottonseed-oil mills were conducted during the early part of the milling season. Reports were received of approximately 20 fires in southern cottonseed-oil mills, with a loss aggregating $900,000. Approximately two-thirds of these fires occurred in Texas oil mills.

*Explosions and fires in threshing machines.*—Further recognition of the dust-collecting fans developed by the department, in cooperation with various manufacturers of threshing machinery, has resulted in a natural saving to farmers in rates for insurance. Insurance rates for the 1923 season in the State of Washington were reduced an additional $2 per $100 of insurance for grain threshing machines fully grounded and properly equipped with an effective fan. The original rate in the Pacific Northwest was approximately $11 per $100, while the new rate made effective June 21 is $7 per $100, a reduction of $4 per $100. Arrangements have been made for the manufacturing companies to construct fans embodying the specifications worked out by department engineers, and the bureau is cooperating with the State fire marshal of Washington and other State officials in this work.

### DEHYDRATION OF FRUITS AND VEGETABLES.

Under an authorization for the study and improvement of methods of dehydrating materials used for food and to disseminate

information on the value and suitability of such products for food, work has been continued in the development and improvement of a food-dehydration industry.

During the year experimental work on the dehydration of spinach was carried on. Ten tons of green spinach was dehydrated and distributed as samples and sold. The comments upon the quality of the product have been entirely favorable. While it is too early to report upon the keeping quality of the dehydrated product, it had a better color than that usually found upon the market. A careful study of the cost of material and of manufacture indicates that an industry in dehydrated spinach could be carried on satisfactorily in some parts of California where the dehydrator may be used for fruit when not drying spinach.

Experimental work was done in dehydrating cull oranges. About 2,700 pounds of dehydrated oranges was obtained from 10 tons of fresh material. This fruit was cull material and showed approximately 50 per cent waste. Some work was done on both cauliflower and onions, the results bringing out special problems which need further investigation before methods can be recommended for the utilization of the surplus crops of these vegetables. Attention was also given to methods for dehydrating cherries and rhubarb. A bulletin on dehydration, giving the data obtained from the experimental work, is in course of preparation.

### IMPROVING PRODUCTION OF ROSIN AND TURPENTINE.

Naval stores of which turpentine and rosin are the most important, are farm and forest products that enter commerce in the form of paints, varnishes, soaps, paper and textile sizes, polishes, and innumerable other manufactured articles. Twenty-five million dollars' worth of turpentine and rosin are thus used in this country each year and quantities of approximately the same value are exported annually.

The investigations of methods of producing, weighing, handling, and grading and of the uses of rosin and turpentine have been continued.

The work is along two general lines: (*1*) Research on the properties of turpentine and rosin to determine the characteristics that control their adaptability to various uses, on improvements in methods of using turpentine and rosin, and on the differences between similar products made from the oleoresin or gum of the living tree and those made by steam or destructive distillation of pine wood; (*2*) laboratory and field studies on improvements on the methods of producing, packing, handling, shipping, and grading these commodities and other less important naval stores derived from the pine tree, as well as a study of the adulteration and methods of analysis, detecting the extent of adulteration, and the formulation of specifications for naval stores. Statistics are collected annually on the consumption of turpentine and rosin in the various industries and on the stocks held by consumers and by dealers and jobbers at the principal distributing points of the country. These statistics are published each year jointly with the statistics of the Bureau of the Census on production and stocks held by producers, in the preparation of which the Bureau of Chemistry assists.

Much work was done in perfecting the type samples for naval stores. Like rosin, turpentine is graded on the primary markets on its color, and preliminary standards for the various grades of turpentine have been prepared. Several sets of these standards are now in the hands of the trade for trial and comment. In order to make sure that the standard rosin types, which are now, under the naval stores act, the United States rosin standards, are kept in perfect condition, all sets have been recalled from the depositories, thoroughly overhauled, calibrated, and redeposited. This work must be done every year.

Demonstrations were made of improved processes for preparing rosin and turpentine. The bulk of the naval stores produced in this country is made at smaller places, owned in many instances by farmers in the Southern States. The naval stores industry is thus largely a plantation industry, where the possibilities for financial loss through wasteful methods of operation, insufficient and incorrectly designed equipment, poor location of plant, and faulty handling of the finished products are numerous. Most of the demonstration work is done in the field by an experienced naval stores man, who visits the naval stores places and demonstrates better methods of production and the elimination of wastes as adapted specially to the still under consideration.

## COLOR, MEDICINAL, AND TECHNICAL INVESTIGATIONS.

The Bureau of Chemistry maintains a laboratory and a small experimental factory at the Arlington Experimental Farm to do the work authorized in the appropriation act as follows, "For investigations and experiments in the utilization, for coloring, medicinal, and technical purposes, of raw materials grown or produced in the United States."

### INVESTIGATION OF COLOR SUBSTANCES.

The investigation of color substances is directed along lines which will help the manufacturer of dyes and intermediates to acquire better control of factory processes and to improve the quality of the products. This is accomplished by undertaking exhaustive studies on the physical and chemical properties of the crudes, intermediates, and dyes, and on those basic reactions which have a bearing on the whole industry. Special emphasis is placed on the development of new or improved methods of analysis for the detection and determination of the intermediates. The laboratory is well equipped with apparatus for production and tests on a semimanufacturing scale, with which uniform batches of the substances studied may be obtained, and with which new processes may be studied on a larger scale than is possible in an ordinary laboratory. Cooperation not only with manufacturers but also with users of dyestuffs is encouraged to the fullest extent. Upon occasion the laboratory will produce special dyes which are needed for important work and which are not obtainable elsewhere, until a manufacturer can be interested in their production. The function of this laboratory is to aid in a stimulative, noncompetitive way the development of the American dye industry.

During the year the work included the standardization of biological stains used to identify disease organisms. The chemical

examination of the stains for identity, purity, and color strength is made. An improved method for the purification of tolidine was worked out. A process for the purification of benzidine also has been developed. A critical study is being made of the sulfonation of hydrocarbons, both by the old batch processes and by the continuous vapor phase process developed in this work. A paper giving the results of work on the sulfonation of cymene is in course of publication. Work was done on sulfonated indigotine, on dyes derived from cymene, on metallic salts of direct dyes, on the absorption curves of the permitted dyes, and on water of crystallization in dyes.

During the year 510,586 pounds of coal-tar colors were certified as suitable for use as food colors. Manufacturers of food products are recognizing more and more the value of certified colors, and the number of firms manufacturing such colors is steadily increasing, as is also the quantity of color offered for certification.

During the year 12 articles giving the results of the work in the color investigation laboratory have been published and 5 public-service patents have been granted on processes developed.

### FURFURAL EXPERIMENTS.

Investigations on the manufacture of furfural and adhesives from corncobs and other crop wastes have been practically completed. A little further work is necessary on the development of certain uses for furfural, and to complete the preparation of the results for publication. Practical methods for the manufacture of furfural and adhesives from corncobs and other crop wastes at a comparatively low cost have been developed. Furfural has not been extensively used heretofore in the technical arts, because the cost of production was too great. It can now be manufactured at a cost that indicates that it may be used rather extensively as a substitute for formaldehyde in making synthetic phenol resins of the Bakelite type, as a paint and varnish remover, as an intermediate, with amines, in the production of soluble resins for varnishes and lacquers, as a repellent for the blow-fly, and as a possible intermediate in the production of mucic and pyromucic acids.

Work on the manufacture of adhesives from corncobs has been previously reported.

## WORK FOR OTHER DEPARTMENTS.

Under an authorization for collaboration with other departments of the Government desiring chemical investigations, whose heads request the Secretary of Agriculture for such assistance, the Bureau of Chemistry does a great variety and volume of work, ranging from the testing of supplies furnished on contract to see that they comply with specifications to serving as a consulting expert on chemical problems.

Assistance is given the Post Office Department in developing cases involving the fraudulent use of the mails for the sale of fake medicines and appliances falsely claimed to cure diseases. Analyses are made of drugs, cosmetics, depilatories, fat reducers, poisons, narcotics, and commodities suspected of containing harmful agents. Assistance is also rendered the Post Office Department in collecting and preparing evidence for court cases where technical subjects are

involved, and expert testimony is furnished at hearings and in court cases. The sale of certain fraudulent remedies can be checked more effectively in some instances under laws administered by the Post Office Department than by action under the food and drugs act.

Several departments of the Government receive expert assistance in preparing specifications for the purchase of foods, drugs, chemicals, leathers, leather goods, paper, waterproofing materials and fabrics that have been waterproofed, rosin, turpentine, and the like, since specialists working on these commodities are available in the Bureau of Chemistry. Tests and analyses are made of samples of shipments of these commodities, which have been delivered on contract, in order to determine whether or not they comply with the specifications under which they were purchased. Practically all laboratories in the Bureau of Chemistry do testing and analytical work for other departments of the Government. The work of testing foods and drugs for the Army and the Navy is especially voluminous.

Paper investigations have been made to assist the Federal Specifications Board in the preparation of specifications, on the improvement of methods of examination and on the study of fruit and vegetable wrapping paper, and to assist the Joint Committee on Printing of Congress and other departments in the examination and preparation of specifications for papers. Three publications on these subjects have been prepared.

The specialists of the Bureau of Chemistry are constantly called upon by departments and independent establishments of the Government for advice regarding problems involving a knowledge of the science of chemistry. Because of the comparatively large number of chemists in the organization and the wide range of subjects covered by the work of the bureau, it is possible to furnish information and advice on a great variety of problems. This service makes it unnecessary for chemical laboratories to be maintained in a number of departments which have considerable chemical work to be done. The cost of maintaining small individual laboratories in several departments would be much greater in the aggregate to the Government than the cost of having the work done in the Bureau of Chemistry as an incident to its other chemical work.

## ENFORCEMENT OF REGULATORY LAWS.

### TEA INSPECTION ACT.

During the last fiscal year, 96,267,920 pounds of tea was examined for quality and purity at the ports of entry. Of this quantity 277,104 pounds, or 0.29 per cent, was rejected. This represents the smallest percentage of rejections in the last 12 years. Of the total quantity rejected, only 2,440 pounds was rejected for purity and this occurred in the case of a China green tea. All the other rejections were for quality.

The most noticeable increase in quantity imported was of Japanese green teas, of which more than 25,000,000 pounds was imported, as compared with about 17,000,000 pounds imported during 1922. The importation of China black teas was nearly twice that of the previous year, but there was a great decrease in the importation of China green teas. Of the total quantity offered for entry during

the year, 52 per cent was black tea, 35 per cent was green tea, and 13 per cent was Oolong tea. Japan, including Formosa, furnished approximately 38 per cent of the total; China, 15 per cent; India and Ceylon, 36 per cent; Java and Sumatra, 10 per cent; and other countries, about 1 per cent.

The largest rejections occurred in the case of Japanese green teas, owing to the fact that the rejected teas contained "woody floaters." The Japanese Government has already taken steps to regulate the manufacture of their teas so as to prevent a recurrence of this condition. The next largest rejections occurred in the case of Congou teas. The reason for this was that many old Congou teas had been mixed with the new crop and were so predominant in the mixtures that the teas were rejected on account of quality.

Table 1 shows the results of the examination of teas in the tea-inspection districts.

TABLE 1.—*Results of examination of imported teas.*

| Point of examination. | Tea examined. | Tea passed. | Tea rejected for quality. | Tea rejected for purity. | Tea rejected for purity and quality. |
|---|---|---|---|---|---|
| | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* | *Pounds.* |
| Boston | 16,559,221 | 16,551,853 | 7,368 | ..... | 7,368 |
| Chicago | 5,075,454 | 5,059,043 | 16,411 | ..... | 16,411 |
| Honolulu [1] | 57,128 | 57,128 | ..... | ..... | ..... |
| Puget Sound | 11,657,731 | 11,654,961 | 2,770 | ..... | 2,770 |
| St. Paul | 1,314,199 | 1,313,800 | 399 | ..... | 399 |
| San Francisco | 11,977,661 | 11,950,328 | 27,333 | ..... | 27,333 |
| New York | 49,626,526 | 49,403,703 | 220,383 | 2,440 | 222,823 |
| Total | 96,267,920 | 95,990,816 | 274,664 | 2,440 | 277,104 |

[1] Includes examinations made in May and June. Before May teas imported at Honolulu were examined at San Francisco.

## NAVAL STORES ACT.

The enforcement of the naval stores act, which was signed by the President on March 3, 1923, and went into effect June 1, 1923, has been assigned to the Bureau of Chemistry by the Secretary of Agriculture.

The act defines and establishes classes and grades for the several kinds of turpentine and of rosin, makes the rosin types prepared by the Bureau of Chemistry the United States official standards for rosin, authorizes the Secretary of Agriculture to revise or make new standards, requires the sale in interstate and foreign commerce of all turpentine and rosin under the standards provided, makes unlawful the use of words, parts, or derivatives of words resembling "turpentine" or "rosin," or of any misleading or false word or words in advertising, offering for sale, shipping, or selling anything which is not naval stores of the standards provided in the act. The law also authorizes the Secretary of Agriculture, upon request of interested persons, to examine and grade naval stores and to issue a certificate showing the analysis, classification, or grade, which certificate shall be prima facie evidence in any court. For this service the Secretary is authorized to make a charge intended to cover the cost of such work.

No funds have so far been provided for the enforcement of the act. Work on the preparation of regulations under the act is being done,

an organization for its enforcement is being created, and much correspondence on the subject is being conducted.

### FOOD AND DRUGS ACT.

The report for the fiscal year ended June 30, 1922, referred briefly to the installation of the project system for the enforcement of the food and drugs act. The project system involves the formulation of a comprehensive and unified plan of operations for the entire field force, directed against specific classes of products which experience has shown to be most likely to be found in violation. Upon the completion of a campaign upon any type of products a detailed report covering the entire field of operations is prepared. A comparison of the reports for succeeding fiscal years furnishes a ready means of determining how successful the efforts have been to bring about a compliance with the requirements of the law. Such a comparison of reports made during the last year shows encouraging improvements in conditions in some classes of products, while in others continued regulatory activity is obviously necessary.

Experience in the enforcement of the food and drugs act has shown that where violations in staple foods are encountered the objectionable conditions are as a rule readily demonstrated to the courts and therefore easily corrected. Violations involving the less important food products are frequently of a more intangible character, difficult to establish by the usual court procedure, although they usually result in very real financial loss to the purchaser.

Because of this condition an apparently disproportionate amount of the time and energy of the regulatory force must be devoted to the nonstaple food products. In the knowledge, however, that adulteration and misbranding, if existent in the staple foods, are likely to have a most serious effect upon the public welfare, the bureau has given special attention to these types of foods.

*Flour.*—The report for the last fiscal year made brief reference to actions against shipments of flour. Many shipments, especially those moving to the western section of the United States, were short in weight or contained excessive moisture. The weight shortages and moisture excesses observed were greater than could be accounted for by normal changes during shipment and in the aggregate represented very serious losses to the consignees. The campaign of seizures begun last year was therefore continued, with the result that with few exceptions flour of full weight and standard moisture content is now being shipped.

*Butter.*—For several years attention has been given to interstate traffic in butter and action has been taken against many shipments which were high in moisture, low in butterfat, or short of the declared weight. The difficulty of enforcing the law as applied to butter has been very greatly lightened by the passage at the last session of Congress of an act establishing a standard for butter, which fixes 80 per cent as the minimum butterfat content. During the year 64 seizures against adulterated and misbranded butter and 117 criminal prosecutions were instituted.

An interesting and unusual feature of the work was the discovery that a concern in Jersey City, N. J., was adulterating butter with coconut oil or other foreign fat and shipping it to Philadelphia.

Seizures were promptly made, as a result of which the offending firm discontinued operations.

*Eggs.*—Continued work was performed on interstate shipments of shell eggs. The educational work by Federal and State officials in having eggs candled as near as possible to the place of production has done much to eliminate decomposed eggs from interstate commerce. This year a decided improvemnt in the quality of the eggs shipped was noted in several sections of the United States. Forty-nine prosecutions and 44 seizures were instituted during the year, because of the shipment of decomposed eggs.

In recent years the traffic in frozen and dried eggs, which are used extensively by hotels and bakeries, has assumed large proportions. The quality of the eggs used, as well as the sanitary conditions under which the dried or frozen products were prepared, has been investigated. Careful inspection of the large quantities imported was made at ports of entry, in order to exclude the consignments unfit for food or otherwise adulterated or misbranded. Four prosecutions and seven seizures were made during the year because of the interstate shipment of adulterated frozen eggs.

*Salmon.*—A discouraging phase of the regulatory work has been the persistent practice by certain packers of canning decomposed salmon. Seizures of 86 shipments of canned salmon were made and 10 criminal prosecutions were inaugurated during the year. The marketing of this type of product, notwithstanding the bureau's previous activity, indicates a degree of deliberation or extreme negligence on the part of some packers which calls for continued and intensive regulatory activity.

*Jams and jellies.*—The investigational work alluded to in the last report for the development of methods for the analysis of products labeled as fruit jams and jellies, which contain excessive added pectin and are deficient in fruit, has progressed to a point where it has been possible to take action against many shipments of such products. Thirteen prosecutions and 38 seizures were developed during the year.

Attention was centered chiefly on jams and jellies made with excessive quantities of added pectin which were labeled as true fruit products. In some instances so-called fruit jellies were found to be made wholly of pectin, sugar, water, citric or tartaric acid, and artificial color, containing no true fruit or fruit juice. In other cases products contained some true fruit, varying from a quantity sufficient for coloring only up to quantities barely sufficient to convey a faint fruit flavor.

The bureau's activities on these products have been met in a gratifying manner by the trade. The seizures have so far been adjusted without contest by the entry of consent decrees and release under bond, for appropriate relabeling. Furthermore, there has been a very general adoption of new and informing labels. The campaign has thus largely eliminated unfair competitive conditions heretofore existing and has in great measure insured the purchaser against fraud and deception.

*Slack-filled canned goods.*—A can of food in which water, brine, or sirup in excessive quantities has been substituted for the food which the can purports to contain is said to be "slack filled." Such an article is adulterated, in that a liquid has been substituted in whole

or in part for the article. From time to time the bureau has issued service and regulatory announcements giving the weights of certain foods, exclusive of liquid, which cans of different sizes should hold. During the year many seizure actions were directed against this form of violation, especially against canned shellfish. Several seizures of slack-filled canned vegetables were also made. As none of these actions have been contested, it is to be anticipated that the packers of the goods in question will in future market full-packed cans.

*Imitation fruit beverages.*—Reference has been made to violations occurring in nonstaple products which are difficult to demonstrate but which result in imposition upon the purchaser. In this class are the so-called fruit beverages and fruit beverage sirups, which of late years have been widely distributed under labels implying that they are largely or wholly of fruit origin. These products frequently owe their distinctive flavors to synthetics and contain little or no real fruit ingredient. Interstate traffic is restricted almost entirely to the concentrated sirups from which the finished products are manufactured. The bureau has therefore been able to proceed by seizure only against the concentrates, leaving to State or local officials the task of making sure that the finished beverages as locally distributed are properly labeled. The seizures which have been made have led to a satisfactory revision of the labels used upon interstate shipments of many of the beverage concentrates.

### SUMMARY OF PROSECUTIONS AND SEIZURES.

Table 2 indicates the magnitude of the regulatory operations undertaken throughout the year, which can not be given in detail in a short report.

TABLE 2.—*Summary of prosecutions and seizures.*

| Product. | Prosecutions. | Seizures. | Total. | Product. | Prosecutions. | Seizures. | Total. |
|---|---|---|---|---|---|---|---|
| Baking powder | 1 | ..... | 1 | Meal (corn) | ..... | 1 | 1 |
| Beverage sirups and flavors | 7 | 7 | 14 | Meat products | 3 | ..... | 3 |
| Butter | 117 | 64 | 181 | Milk (evaporated) | ..... | 4 | 4 |
| Cacao products | 5 | 11 | 16 | Nuts | 3 | 44 | 47 |
| Colors | 1 | 2 | 3 | Oils | 183 | 23 | 206 |
| Confectionery | 4 | 3 | 7 | Olives | ..... | 2 | 2 |
| Drugs (crude) | ..... | 3 | 3 | Pickles | ..... | 5 | 5 |
| Eggs: | | | | Potatoes | 8 | 11 | 19 |
| Frozen | 4 | 7 | 11 | Remedies | ..... | 146 | 146 |
| Shell | 49 | 44 | 93 | Spices and condiments | 7 | 6 | 13 |
| Feeds | 53 | 51 | 104 | Sugar and table sirups | 1 | 1 | 2 |
| Fish: | | | | Tea | 6 | ..... | 6 |
| Canned | 14 | 102 | 116 | Vanilla beans | ..... | 1 | 1 |
| Shell | 56 | 86 | 142 | Vegetables (canned) | 26 | 33 | 59 |
| Flour | 1 | 33 | 34 | Vinegar | 11 | 51 | 62 |
| Food flavors | 17 | 5 | 22 | Water | ..... | 1 | 1 |
| Fruits (fresh, canned, dried) | 29 | 44 | 73 | | | | |
| Gelatin | 2 | ..... | 2 | Total | 621 | 829 | 1,450 |
| Jams, jellies, and preserves | 13 | 38 | 51 | | | | |

### WORK OF STAFF LABORATORIES.

As a supplement to the statement of completed regulatory work which represents essentially the efforts of the bureau's field force, the work of the regulatory staff laboratories in Washington may be briefly recorded.

In addition to solving problems of a nonregulatory nature described elsewhere in this report, these laboratories collect data and study methods to be employed in applying the terms of the food and drugs act to products upon which necessary knowledge has been lacking.

FOOD CONTROL INVESTIGATIONS.

The investigation on the composition of egg noodles referred to in the last report was continued. The data obtained will be used in the application of the law to products deficient in egg solids.

A study of wheat flour, its manufacture, grading, and use, was continued. Special attention was given to methods for the determination of moisture in flour. About ninety commercial self-rising flours were analyzed chemically and microscopically and subjected to baking tests. Most of the samples examined were of satisfactory quality.

The sardine and clam packing industries in Maine and the oyster industry in New Jersey were investigated. The entire time of one chemist has been devoted to the development of chemical methods for detecting spoilage in canned salmon.

Considerable work was done on canned fruit and vegetables. The technique for the quick detection of small quantities of carminic acid, an added color in tomato products, has been perfected.

An extensive experimental pack of canned grapefruit was prepared by the Savannah and Porto Rico stations. This is now being examined and its keeping qualities in tin observed.

Authentic samples of malt extracts were analyzed, with a view to differentiating between an all-barley malt extract and one made in part from corn. The determinations made do not show any characteristic differences between the different kinds of extracts from a chemical standpoint. Much work was done on dairy products.

STOCK FOODS.

Studies to determine standards and definitions for various cattle feeds sold on the American market were continued. Attention was given to flour by-products and an information sheet on the subject was issued. Work was done on oat and meat by-products as feeds. Studies on the milling of buckwheat and barley are under way. An investigation of the manufacture of precipitated bone and of its merits as a mineral constituent of mixed feeds was made. A method for determining the presence of starch in linseed meal and similar materials containing interfering polysaccharides has been developed and published. A study of the composition of grain sorghums was completed.

Work on the utilization of waste by-products as cattle foods was continued. Department Bulletin 1166, Apple By-Products as Stock Foods, has been issued.

MICROBIOLOGICAL INVESTIGATIONS.

An investigation of oyster spoilage was made. Because of the perishable nature of oysters and the fact that they are often shipped for long distances, studies were made to determine the effect of time, temperature, and methods of handling upon the keeping quality of

shucked oysters, as well as the nature of the spoilage, the numbers and kinds of bacteria present in decomposing oysters, and the criteria by which it is possible to determine whether oysters are fresh, stale, or sour. The results of the investigation to date indicate that a test for hydrogen-ion concentration of the oyster liquor may supplement the organoleptic examination in determining the quality of shucked oysters. It is also indicated that a determination of the total numbers of bacteria present in decomposing oysters is of no value in judging the quality of oysters.

In work on the classification of bacteria in food products, a new method for separating the several sections or subgroups of the colon group of bacteria has been found. This method has been applied to a large series of cultures collected from soils and from fecal specimens in order to determine its usefulness in differentiating the fecal cultures from those of nonfecal origin. At present the application of this method to the estimation of the sanitary quality of water is being studied. Two papers giving the results of this work are now in press. It is believed that the continuation of this work will simplify and improve the methods used in the identification of pollution organisms in water supplies.

Work on a comparative study of the floras of spoiled canned foods was continued. Several cultures from food-poisoning outbreaks were collected and studied. A rather large collection of type cultures of *Bacillus botulinus* and of the para-typhoid-enteritidis group have been kept in stock.

A study of the biological factors in the deterioration of forage and feeding stuffs is under way. The possible agency of pure cultures of particular molds in animal disease is being tested in feeding experiments. Later it is proposed to deal with mixed cultures. In this way it may be possible to determine to what extent spoilage in feeding stuffs becomes a source of loss of domestic animals.

Cultural studies of Penicillium and Aspergillus and species of related genera were continued. The large collection of mold cultures maintained now includes about 900 numbers, representing species and strains obtained from widely different sources. During the year 238 cultures were furnished to correspondents for the identification and verification of molds.

The many data accumulated during the cultural work under this project, now in its twentieth year in the department, necessitated a restudy of the basis for nomenclature in the groups Penicillium and Aspergillus. This monographic undertaking has reached the form of a preliminary manuscript, but it will require one or more years for completion, since it is carried on in the intervals between other work.

During the year work was continued upon fermented foods—the methods of their preparation and preservation and a study of the organisms concerned in such fermentations. Fermentation of cucumbers raised at the Arlington Experimental Farm was continued, special attention being given to the relation which the quality of the cucumbers bears to the resulting pickles. Additional studies were made on the bacterial spoilage of pickles during fermentation. Cabbage was also fermented and sauerkraut was canned experimentally, on the basis of both a household and a commercial product.

Special attention was given to determining the cause of swells in canned sauerkraut and the proper procedure in canning to prevent this difficulty and at the same time produce the most desirable product. In this work No. 3 cans, subjected to a 10-minute exhaust in steam during the canning process without further processing, were sterilized. They were much less subject to swell than were cans handled in the ordinary commercial manner, which usually includes a very short exhaust and a very short process in the retort. Cans handled in the ordinary commercial manner were found to be unsterile and in most cases produced gas and corroded the metal of the container.

The work done upon soy sauce fermentation was published as Department Bulletin 1152, Soy and Related Fermentations.

### MICROCHEMICAL INVESTIGATIONS.

An investigation of decomposition in filberts imported from Italy was made. Experimental work was continued on the decomposition of small fruits, especially cherries and strawberries, both in the field and in the laboratory. The manufacture of apple butter was studied and a general survey of apple butters on the market was made, with a view to determining the quality of the various materials employed. An investigation of the pollen in honey was continued. Investigational work is in progress to determine what effect the fineness of the grind has on calculating the quantity of cacao shell in cacao products. Work on tomato products was continued.

The method on the microscopical examination of flour referred to last year has been simplified and the new method is described in Department Bulletin 1130, Significance of Wheat Hairs in Microscopical Examination of Flour.

The results of a crystallographic study of the calcium oxalate crystals in official plant drugs have been published in collaboration with the Laboratory of Crop Chemistry.

The preparation of a table of optical constants of various organic crystalline compounds is in progress.

A large number of flour and feed mills in the Middle West have been visited to obtain information on the source and methods of handling grain by-products used in feeds. The handling of packing-house by-products was also studied.

### WATER AND BEVERAGE CONTROL.

Sanitary surveys of certain springs from which mineral waters are sold were made. A method for the examination of imitation grape flavors was perfected. Several samples of alleged radioactive pads and of water and drugs, the labels of which bore statements that the products contained radium, were analyzed.

In the interest of the shellfish industry, trade waste surveys were made of the Housatonic River and the New Haven Harbor, Conn., in cooperation with the Bureau of Fisheries.

Methods were developed for the manufacture of flavoring sirups and extracts from cassina leaves. An investigation of the suitability of various solvents for extracting vanilla beans was begun.

DRUG CONTROL.

The work under the food and drugs act on drugs and medicinal products was reorganized during the year. An office of drug control was established to coordinate the entire work of the bureau on these products. This office will function in reference to drugs and medicines in the same manner that the food control laboratory functions with respect to foods. The chemist in charge will act as a staff adviser to the chief of the bureau in applying the provisions of the food and drugs act to drugs and medicinal products. Plans for the operation of this office now being formulated will be put into effect during the fiscal year 1924.

This office maintains a laboratory to work out special problems arising in connection with the chemical analysis of drugs, particularly with respect to the accuracy, adequacy, and adaptability of analytical methods to the various preparations to which they are to be applied. It is essential to know the conditions under which various analytical methods can be relied upon and what factors influence the results and to what extent. New methods for products for which no methods or only defective methods have heretofore been available, or for new medicaments which are continually being proposed, are essential to an adequate administration of the law as it relates to drugs.

The products coming within the scope of this office may be divided into four classes: (*1*) Crude drugs, including herbs, leaves, bark, roots, flowers, gums, etc.; (*2*) manufactured drug materials, such as synthetic preparations, inorganic compounds, extracts and fluid extracts of crude drugs, ferments, glandular extracts, and all other manufactured ingredients entering into the composition of medicines; (*3*) pharmaceutical preparations, such as hypodermic and other tablets, pills, medicines in capsules, wafers, etc., and all liquid and solid preparations having a recognized standard and intended for use as medicines without further manipulation; and (*4*) "patent medicines."

PHARMACOGNOSY INVESTIGATIONS.

Work to establish a scientific classification for plant species yielding mustard seed is under way. Seeds yielding this desirable condiment are similar and closely related to other seeds useful for fixed oil, but not for condimental purposes. This work, partly completed, deals in a comprehensive way with the anatomy and chemistry of the seed and the morphology of the plants. The chemistry comprises a study of the glucosides isolated and of the volatile oils yielded thereby. Thus, by establishing the definite chemical and anatomical characteristics of the seeds and the morphological characteristics of the plants, a satisfactory supply of seeds is assured. The methods of analysis have been materially improved and a new apparatus effecting uniform and efficient heat for the distillation of the volatile oils has been constructed. New species, mainly of oriental origin, have been made available for condimental and medicinal use and for fixed oil utilization.

Experiments on sublimation were conducted. Many plants and certain animal products used for medicinal, food, or other purposes contain substances of crystalline, sublimable nature. Some of these

substances represent the active constituents which usually must be isolated by involved methods of liquid extraction, precipitation, and purification. Less material, time, and money is needed if these substances can be isolated by sublimation. The quantity of material submitted for identification or examination is often limited. Attention has therefore been given to the development of sublimation. Extensive data on macrosublimation and microsublimation have been collected from the literature. Waste products of plant and animal origin have been examined, with striking success. It is found that the active substances usually can be obtained in a pure, or practically pure, state by fractional sublimation, preferably using diminished pressure. Apparatus for sublimation, microsublimation, and micromelting-point determinations, and an electrically heated oil bath have been developed.

A study was made of the occurrence and distribution of hydrocyanic acid or cyanogenetic compounds in plant products. Many products would be safely available for food or feed purposes but for the fact that they may develop hydrocyanic acid (prussic acid) in injurious quantities. One species (*Phaseolus lunatus*) yields many varieties of beans, all of which produce hydrocyanic acid upon maceration of the bean meal. Fortunately, domestic forms yield such small quantities that they can be consumed without danger. Many tropical varieties have been found to contain dangerous quantities. Detailed anatomical, chemical, and morphological data, which will be helpful in effecting an efficient control of the seeds, have therefore been collected. There is much evidence that the quantity of glucoside formed in the beans is an inherited factor and is characteristic of the particular strain.

Similar work is being carried out with seeds of bird's-foot trefoil, to be introduced by the Bureau of Plant Industry as an early forage crop. The plants tested thus far have yielded dangerously large quantities of hydrocyanic acid. The aim is to follow the procedure adopted in the study of *Phaseolus lunatus*, in the hope that strains of seed yielding such small quantities that the plants may be grown as a safe forage crop may be obtained.

It was found that the inert and objectionable material in crude drugs and spices can be removed effectively by selective siftings. A study was made of green and roasted coffee to develop means for the identification of coffee as to origin. During the year data were collected in connection with the revision of the United States Pharmacopœia and National Formulary.

### PHARMACOLOGICAL INVESTIGATIONS.

The pharmacology of zinc, tin, and other heavy metals is being studied. Data which show the comparative toxicity of the metals are being collected. One of the purposes of this work is to develop new criteria by which toxicity may be studied and to make results of animal experiments more useful in setting food standards. A toxicity study of various arsenical insecticides was made. The results indicate that the insecticides can be considered practically as toxic as inorganic arsenious oxide. Results of work on the pharmacology of cadmium and zinc were published during the year.

Studies are being made of the pharmacology and toxicology of fat-soluble and water-soluble dyes which may be suitable as food colors.

### IMPORTED FOODS AND DRUGS.

The joint regulations of the Department of Agriculture, the Department of Commerce, and the Treasury Department governing procedure on importation of goods subject to the food and drugs act were issued near the close of the fiscal year ended June 30, 1922. The past year has given opportunity to test these regulations in practice and they have been found satisfactory on the whole. In its import inspection the bureau is continually handicapped by the smallness of the force available to cope with the great volume of imports daily arriving at the larger ports, especially New York. In full appreciation that delays are costly to importers, every effort is being made to expedite inspections, and continued improvement in this respect may be anticipated.

### REGULATIONS AND FOOD STANDARDS.

A revision of the rules and regulations for the enforcement of the food and drugs act of June 30, 1906, as amended, was issued during the year as Office of the Secretary Circular 21, eighth revision. This is the first complete revision of the regulations.

Upon the recommendation of the joint committee on definitions and standards, standards and definitions were published during the year for the following products: Ginger-ale flavor, ginger ale, cayenne pepper, oil of cassia, cacao butter, breads, condensed milk, butter, renovated butter, cacao beans, cacao nibs, chocolate, sweet chocolate, milk chocolate, cocoa, sweet cocoa, sweet milk cocoa, mustard, and mustard products.

The list of coal-tar colors admitted to certification for use in foods was amended by the addition of a green shade, Guinea green B.

### COOPERATION WITH STATE AND CITY OFFICIALS.

The work of enforcing the Federal food and drugs act is greatly facilitated by close cooperation with State and city officials who are engaged in enforcing State laws and municipal ordinances relating to foods and drugs. Information developed by investigations made by Federal officials is often helpful to State and city food-control officials, and the State and city officials likewise furnish much information of value to Federal officials. Inspections of food factories are frequently made jointly by Federal and State inspectors. Some undesirable conditions in the distribution of food can be corrected more quickly and effectively under State than under Federal law. In other instances, the operation of the Federal law in connection with a particular form of adulteration may make regulatory action on the part of a State unnecessary.

The office of cooperation, which is maintained in the Bureau of Chemistry for the prime purpose of promoting effective cooperation among Federal, State, and city food and drug officials, has made gratifying progress in promoting team work.

### INTERESTING COURT DECISIONS.

A number of appellate court decisions of outstanding interest were rendered during the year.

The Circuit Court of Appeals for the Ninth Circuit, in reversing the decision of the lower court against the Government in a case in which a shipment of salmon was libeled on the ground that it contained decomposed fish, defined the word "article" as used in the act and held that in a shipment of a food product in containers it is not necessary for the Government to prove that each individual can is adulterated.

In a seizure action brought against a product labeled as "Sparkling White Seal," which consisted of artificially carbonated apple juice flavored with capsicum, the Government alleged misbranding, holding that the name of the article and the general design and appearance of the bottled article simulated "White Seal Champagne." A verdict for the Government in the lower court was affirmed by the Circuit Court of Appeals for the Third Circuit, which held that evidence as to resemblance between the bottles and labels of the article in question and those used for champagne sold under the same name was a question of fact for determination by the jury.

The Circuit Court of Appeals for the Sixth Circuit reversed the decision of the lower court, which held that the label "Apple Cider Vinegar" constitutes a misbranding when used upon a vinegar made from evaporated apple products. A motion by the Government for a rehearing was denied, whereupon, with the consent of the Attorney General, proceedings were instituted with a view to a review of the case by the Supreme Court.

A consignment of coal-tar color offered for food purposes was seized on the ground that it was adulterated with salt and arsenic and misbranded in being labeled, "Warranted complies with all requirements." The verdict of the lower court upholding both charges was reversed by the Court of Appeals for the Seventh Circuit in so far as adulteration was concerned, but affirmed as to misbranding.

The Circuit Court of Appeals for the Sixth Circuit affirmed the judgment for the Government rendered by the district court in a criminal action brought against the manufacturer of a product known as "Eggno," represented to be a substitute for eggs in baking and cooking.

# REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
*Washington, D. C., September 10, 1923.*

SIR: I have the honor to transmit herewith a report covering the operations of the Bureau of Soils for the fiscal year ended June 30, 1923.

Respectfully,

MILTON WHITNEY,
*Chief of Bureau.*

Hon. H. C. WALLACE,
*Secretary of Agriculture.*

## SOIL SURVEY.

During the fiscal year ended June 30, 1923, detailed soil surveys were begun or completed in 68 separate areas located in 26 States, and 27,004 square miles, or 17,282,560 acres, were surveyed. Reconnaissance surveys were conducted in Montana and Texas and 18,758 square miles, or 12,005,120 acres, were surveyed. In all of these States the Soil Survey work was carried on in cooperation with some State organization, such as the agricultural college, experiment station, department of agriculture, or geological survey. The bureau has been unable to meet fully the demands of the States for cooperative work, and in meeting these requests as far as possible it has been necessary to temporarily discontinue survey work in some of the noncooperating States, although survey work in these States is essential in the construction of a soil map of the United States.

The total area covered by detailed surveys from the inception of the work to and including June 30, 1923, amounts to 629,747 square miles, or 403,038,080 acres, and by reconnaissance surveys 553,358 square miles, or 354,149,120 acres.

Tables accompanying this report show the areas surveyed during the fiscal year just closed and the total area surveyed in each State up to the present time.

TABLE 1.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1923.*

DETAILED.

| State. | Area. | Area surveyed. | |
|---|---|---|---|
| | | Square miles. | Acres. |
| Alabama | Cherokee County | 152 | 97,280 |
| | Greene County | [1] 465 | 297,600 |
| Arkansas | Baxter County | 311 | 199,040 |
| | Bradley County | 217 | 138,880 |
| | Clay County | 278 | 177,920 |
| | Nevada County | 322 | 206,080 |
| California | Coachella area | 374 | 239,360 |
| | Gilroy area | [1] 315 | 201,600 |
| | Hollister area | [1] 277 | 177,280 |

[1] These figures do not include portions of these areas surveyed in previous years.

TABLE 1.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1923*—Continued.

DETAILED—Continued.

| State. | Area. | Area surveyed. | |
|---|---|---|---|
| | | Square miles. | Acres. |
| Georgia | Bibb County | 277 | 177,280 |
| | Dooly County | 397 | 254,080 |
| | Jenkins County | [1] 342 | 218,880 |
| Idaho | Minidoka area | 340 | 217,600 |
| Indiana | Lawrence County | 455 | 291,200 |
| | Monroe County | [1] 298 | 190,720 |
| Iowa | Delaware County | [1] 466 | 298,240 |
| | Floyd County | [1] 388 | 248,320 |
| | Jefferson County | 431 | 275,840 |
| | Winneshiek County | 686 | 439,040 |
| | Worth County | 408 | 261,120 |
| | Harrison County | 124 | 79,360 |
| | Plymouth County | 106 | 67,840 |
| Maryland | Garrett County | 685 | 438,400 |
| Massachusetts | Worcester County | 956 | 611,840 |
| Michigan | Kalamazoo County | [1] 302 | 193,280 |
| | Manistee County | 538 | 344,320 |
| | Van Buren County | 617 | 394,880 |
| | Berrien County | [1] 50 | 32,000 |
| | Ottawa County | [1] 29 | 18,560 |
| Minnesota | Olmsted County | [1] 337 | 215,680 |
| Mississippi | Perry County | [1] 445 | 284,800 |
| | Harrison County | 296 | 189,440 |
| | Jackson County | 156 | 99,840 |
| Missouri | Boone County | 406 | 259,840 |
| | Ray County | 571 | 365,440 |
| | Lawrence County | 228 | 145,920 |
| Nebraska | Burt County | 375 | 240,000 |
| | Cuming County | 577 | 369,280 |
| | Dawson County | 985 | 630,400 |
| | Merrick County | 463 | 296,320 |
| | Nance County | [1] 346 | 221,440 |
| Nevada | Las Vegas area | 302 | 193,280 |
| | Moapa Valley area | 115 | 73,600 |
| New Jersey | Bergen area | [1] 502 | 321,280 |
| | Salem area | [1] 185 | 118,400 |
| New York | Genesee County | [1] 161 | 103,040 |
| | Herkimer County | 483 | 309,120 |
| North Carolina | Camden and Currituck Counties | 512 | 327,680 |
| | Haywood County | 546 | 349,440 |
| | Sampson County | 597 | 382,080 |
| North Dakota | Cass County | 1,006 | 643,840 |
| Ohio | Madison County | 282 | 180,480 |
| | Fulton County | [1] 202 | 129,280 |
| Oregon | Polk County | 709 | 453,760 |
| | Linn County | 350 | 224,000 |
| South Dakota | Grant County | [1] 511 | 327,040 |
| | Vivian area | 325 | 208,000 |
| Tennessee | Dickson County | 549 | 351,360 |
| Texas | Cameron County | 625 | 400,000 |
| | Dickens County | [1] 435 | 278,400 |
| | Rockwall County | 149 | 95,360 |
| | Wichita County | 169 | 108,160 |
| | Henderson County | [1] 633 | 405,120 |
| West Virginia | Grant and Mineral Counties | 810 | 518,400 |
| Wisonsin | Green County | [1] 176 | 112,640 |
| | Green Lake County | [1] 113 | 72,320 |
| | Monroe County | 513 | 328,320 |
| | Pierce County | 253 | 161,920 |
| Total | | 27,004 | 17,282,560 |

[1] These figures do not include portions of these areas surveyed in previous years.

TABLE 2.—*Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1923, and the areas previously reported.*

DETAILED.

| State or Territory. | Work during 1923 (square miles). | Work previously reported (square miles). | Total. | |
|---|---|---|---|---|
| | | | Square miles. | Acres. |
| Alabama | 617 | 48,842 | 49,459 | 31,653,760 |
| Arizona | | 1,738 | 1,738 | 1,112,320 |
| Arkansas | 1,128 | 13,515 | 14,643 | 9,371,520 |
| California | 966 | 22,530 | 23,496 | 15,037,440 |
| Colorado | | 3,038 | 3,038 | 1,944,320 |
| Connecticut | | 1,704 | 1,704 | 1,090,560 |
| Delaware | | 2,276 | 2,276 | 1,456,640 |
| Florida | | 12,206 | 12,206 | 7,811,840 |
| Georgia | 1,016 | 27,720 | 28,736 | 18,391,040 |
| Idaho | 340 | 8,751 | 9,091 | 5,818,240 |
| Illinois | | 6,770 | 6,770 | 4,332,800 |
| Indiana | 753 | 12,946 | 13,699 | 8,767,360 |
| Iowa | 2,609 | 28,801 | 31,410 | 20,102,400 |
| Kansas | | 9,456 | 9,456 | 6,051,840 |
| Kentucky | | 5,020 | 5,020 | 3,212,800 |
| Louisiana | | 15,597 | 15,597 | 9,982,080 |
| Maine | | 2,197 | 2,197 | 1,406,080 |
| Maryland | 685 | 9,229 | 9,914 | 6,344,960 |
| Massachusetts | 956 | 3,480 | 4,436 | 2,839,040 |
| Michigan | 1,536 | 6,964 | 8,500 | 5,440,000 |
| Minnesota | 337 | 5,548 | 5,885 | 3,766,400 |
| Mississippi | 897 | 26,137 | 27,034 | 17,301,760 |
| Missouri | 1,205 | 34,543 | 35,748 | 22,878,720 |
| Montana | | 882 | 882 | 564,480 |
| Nebraska | 2,746 | 32,351 | 35,097 | 22,462,080 |
| Nevada | 417 | 235 | 652 | 417,280 |
| New Hampshire | | 1,411 | 1,411 | 903,040 |
| New Jersey | 687 | 8,341 | 9,028 | 5,777,920 |
| New Mexico | | 596 | 596 | 381,440 |
| New York | 644 | 21,412 | 22,056 | 14,115,840 |
| North Carolina | 1,655 | 33,620 | 35,275 | 22,576,000 |
| North Dakota | 1,006 | 15,115 | 16,121 | 10,317,440 |
| Ohio | 484 | 10,305 | 10,789 | 6,904,960 |
| Oklahoma | | 6,540 | 6,540 | 4,185,600 |
| Oregon | 1,059 | 8,169 | 9,228 | 5,905,920 |
| Pennsylvania | | 16,721 | 16,721 | 10,701,440 |
| Porto Rico | | 330 | 330 | 211,200 |
| Rhode Island | | 1,085 | 1,085 | 694,400 |
| South Carolina | | 23,062 | 23,062 | 14,759,680 |
| South Dakota | 836 | 3,130 | 3,966 | 2,538,240 |
| Tennessee | 549 | 10,067 | 10,616 | 6,794,240 |
| Texas | 2,011 | 38,771 | 40,782 | 26,100,480 |
| Utah | | 2,419 | 2,419 | 1,548,160 |
| Vermont | | 1,175 | 1,175 | 752,000 |
| Virginia | | 9,713 | 9,713 | 6,216,320 |
| Washington | | 10,752 | 10,752 | 6,881,280 |
| West Virginia | 810 | 17,767 | 18,577 | 11,889,280 |
| Wisconsin | 1,055 | 18,911 | 19,966 | 12,778,240 |
| Wyoming | | 855 | 855 | 547,200 |
| Total | 27,004 | 602,743 | 629,747 | 403,038,080 |

RECONNAISSANCE.

| | | | | |
|---|---|---|---|---|
| Alaska | | 31,915 | 31,915 | 20,425,600 |
| Arkansas-Missouri | | 58,000 | 58,000 | 37,120,000 |
| California | | 32,135 | 32,135 | 20,566,400 |
| Kansas | | 39,960 | 39,960 | 25,574,400 |
| Michigan | | 1,322 | 1,322 | 846,080 |
| Minnesota | | 752 | 752 | 481,280 |
| Montana | 7,155 | 5,315 | 12,470 | 7,980,800 |
| Nebraska | | 53,064 | 53,064 | 33,960,960 |
| North Dakota | | 39,240 | 39,240 | 25,113,600 |
| Ohio | | 41,420 | 41,420 | 26,508,800 |
| Pennsylvania | | 41,405 | 41,405 | 26,499,200 |
| South Dakota | | 41,400 | 41,400 | 26,496,000 |
| Texas | 11,603 | 121,132 | 132,735 | 84,950,400 |
| Washington | | 13,115 | 13,115 | 8,393,600 |
| Wisconsin | | 14,425 | 14,425 | 9,232,000 |
| Total | 18,758 | 534,600 | 553,358 | 354,149,120 |

The demand for the Soil Survey reports and for maps and reports covering special areas shows not only that an increasing number of scientific investigators are using information of this kind but also that more men engaged in various lines of business are interested in the results of the work.

Cooperative work with the Forest Service was continued during the year. Special attention was given to the relationship between certain soil types and the character of the forest growth. Information of this kind is of great practical value in the reforestation of cut-over lands.

At the request of the Reclamation Service, Interior Department, this bureau continued the classification of the soils in a number of areas. The information secured will be used mainly in determining the agricultural value of the land in proposed irrigation projects.

The usual cooperative work with other departments of the Government and with experiment stations was carried on during the year.

Numerous inquiries regarding the identification of soil types and the treatment and improvement of soils were answered, and much advice and information was given by correspondence or in person to callers. Exhibits of the work of the Soil Survey were prepared, and a representative from the bureau, accompanied by representatives of other bureaus of the department, visited a number of important fairs for the purpose of presenting and exhibiting the work of the Soil Survey and giving advice on the treatment of soils.

It has been recognized for several years that much valuable work in soils has been done abroad with which the soil investigators in this country were not in close touch, and that many processes of soil development are more clearly shown under the climatic conditions prevailing in parts of Europe than in this country. The behavior of soils under centuries of continued cultivation had also become a subject of interest to soil investigators in this country. The bureau was fortunate during the fiscal year ending June 30, 1922, in being able to send a representative abroad for three months to confer with the soil investigators of other countries and to examine the soils of certain regions in order that they might be compared with the soils of the United States. During this journey Czechoslovakia, Hungary, Rumania, Yugoslavia, Italy, Greece, Germany, and England were visited, and a large number of samples of the typical soils were collected, and as far as time permitted a study was made of the soils in the field with reference to their history and treatment. Especial attention was given to the effect of continual cropping for centuries in these long-cultivated regions. An account of this journey and observations on the soils and agriculture of the countries visited has been prepared and presented to the public in papers and addresses. The samples collected have been compared with the soils of similar regions in this country and turned over to the laboratories of the bureau, which are engaged in an investigation of their chemical and physical properties.

## CHEMICAL DIVISION.

Investigations of the Chemical Division, as in the previous year, were concerned chiefly with colloidal soil material. By modifying the treatment adopted for isolating the colloidal material it was found possible to separate from the larger soil grains more than 60 per cent of all the colloidal matter present in some soils.

Progress was also made in developing methods for determining the total quantities of colloids in soils. It was found that after all colloid possible was removed from the soil the unextracted colloid remaining in the residues could be estimated with considerable accuracy by microscopic count. The results of extraction and microscopic count give a determination of the total colloid present in the soil. A method of determining the colloidal content of a soil from the relative adsorptive capacities of the soil and colloid for dye, water, or ammonia was investigated in considerable detail. It was found that the adsorptive capacity of the soil and colloid for water vapor under certain conditions affords a fair estimation of the total colloid in the soil.

In the past it has been quite generally believed that soils as a rule contain only 1 to 2 per cent of inorganic colloidal material. This idea was based partly on early faulty methods of estimation and partly on peculiar interpretations of what constituted the soil colloids. By employment of the improved methods of estimation it was found that soils may contain as high as 70 per cent of colloidal material.

While the properties of a soil are largely dependent on the total quantity of colloids present, the character of the colloidal material is also of great importance. Considerable progress has been made in measuring quantitatively the properties of the colloids extracted from different soils, and the investigations are being continued. This fundamental knowledge of the soil colloids is very important. In the past there has been considerable speculation regarding colloidal phenomena in soils without an exact knowledge of the properties of the substances supposed to be responsible for the phenomena.

A considerable volume of analytical work has been done on soils in collaborative work with other bureaus and with other divisions of this bureau. Many complete chemical analyses have been made of the different strata present in virgin soils. This work is important in the determination of soil characteristics and forms the basis in part for the classification of many soil types. An investigation is also being made of the variation in the mineralogical and colloid composition of different soil strata. In addition, chemical examinations have been made of a wide variety of soils that are being used by the Bureau of Standards in a test of the influence of the soil on pipe corrosion.

## SOIL PHYSICS.

The study of the influence of colloid on the physical condition of the soil has been continued during this year, and a relation between the colloid content and the mineral content of the soil has been established. This relation shows the great influence of the colloid content upon the bearing strength of soils, and may be of great service in estimating the cohesion of the soil in problems related to the use of soil material in drainage, irrigation, and other engineering work and in tillage operations. A new, improved method of mechanical analysis has been worked out that will express the relative amounts of colloid and mineral grains in the soil. This method gives better insight into the nature of the soil composition and is applicable in the study of agricultural soils as well as soil material to be used in engineering construction.

A study has been undertaken of some of the physical properties of various soil types and the variation of these with the soil horizons. This work is being done in cooperation with the Soil Survey to assist in the classification of soil types.

Routine mechanical analyses of soil-survey samples have been continued, and in addition a large number of samples have been examined for the United States Geological Survey, the Reclamation Service, Bureau of Public Roads, and other offices in the Government.

Regular work on the design and construction of apparatus has been continued, and a number of pieces of special apparatus for use in the laboratories and by the Soil Survey field parties have been constructed.

## FERTILIZER RESOURCES.

During the last fiscal year the bureau continued its general fundamental work to develop our resources in fertilizer materials. It has furnished farmers and others interested in fertilizers technical information regarding fertilizers, lime, and manure, their sources of supply, manufacture, purchase, and mixing, and has advised on many problems pertaining to fertilizers that have arisen in the various departments of the Government.

Work has been continued on the production of phosphoric acid by the volatilization process. One of the details worked out is the best proportions of silica, carbon, and phosphate rock to be used for the rapid evolution of phosphoric acid. From laboratory experiments it has been found that the volatilization of phosphoric acid can be brought about under slightly reducing conditions, including temperatures considerably below those generally considered necessary. It has also been shown that by replacing the sand ordinarily employed in this process with potash-bearing shales, phosphoric acid and potash may simultaneously be evolved at a lower temperature than was thought possible for either phosphoric acid or potash. It would be a distinct advantage technically if both of these materials could be volatilized in one operation, using the shale material as a slagging agent. Outside commercial interests have already expressed a willingness to try out the fuel-fired furnace for producing phosphoric acid as it has been largely developed in this bureau. A bulletin describing the work on the volatilization of phosphoric acid is now in press and will be issued shortly.

A survey of the amount of potash obtainable as a by-product from blast furnaces has been completed and a publication embodying the results has been prepared. It has been definitely established that the potash liberated from furnaces where certain types of ores are used may be utilized commercially by the employment of technical methods already developed, and researches are in progress which are designed to effect improvements in methods so that the potash evolved from all furnaces may be made industrially valuable.

The problem of rendering commercially available the enormous domestic supply of potash represented by the greensand deposits of New Jersey, the alunite deposits of Utah, the leucite deposits of Wyoming, and the cement dust of various parts of the country has been attacked from entirely new points of view. The announcement of conclusions at this time would be premature, but the results obtained to date are of a very encouraging nature and offer the

promise that the cost of extracting potash from these raw materials will be greatly reduced. This work is being carried out with a full understanding and utilization of the results obtained in the extensive war-time investigations of these raw materials. Potash from the western fields must be refined to a high state of purity in order that freight charges to market may be reduced to the minimum, and by-products must be yielded simultaneously to reduce proportionately the cost of producing the potash. These fundamental economic considerations are the basis of present investigations. To solve the problem of extracting potash commercially from the greensands of New Jersey—a problem which thus far has resisted solution—would render available for American agriculture a very large and close-at-hand supply of potash.

Additional articles descriptive of the results obtained in the department's experimental kelp-potash plant at Summerland, Calif., have appeared, and others are ready for publication.

By modifying the process ordinarily used in the preparation of ammonium phosphate so as to include the use of commercial potassium chloride as well as phosphoric acid and ammonium, it has been found that a product of corresponding concentration may easily be obtained which contains all three of the essential constituents of fertilizers. The chemical and physical properties of this material make it admirably suited as a medium for transporting the fertilizing elements and for increasing the concentration of other fertilizer mixtures. Outside interests have taken such an interest in this process as to express a willingness to test out the method on a commercial scale. The bureau has for many years advocated the use of more concentrated fertilizers and the elimination of many of the fertilizer brands, and a striking confirmation of the value of our work has been shown during the last year in a number of conferences held in Chicago, Boston, Baltimore, and other sections of the country, in which definite formulas for fertilizer mixtures were adopted. These formulas were fewer in number and were of higher concentration in the fertilizer ingredients, the average result showing about a 50 per cent increase in the content of essential plant-food constituents carried by the adopted brands over those of about 10 years ago.

A study has been undertaken of conditions suitable for the home mixing of materials and the changes taking place in the mixed materials while in storage.

As a result of the work on nitrogen fixation during the past year an improved method has been evolved for the recovery of ammonia in liquid form from the mixed gases in the synthetic process. This method promises a more efficient recovery, produces the ammonia in a more convenient form than from the older methods, and marks a distinct advance in the technical operation of the Haber process for nitrogen fixation. A report on the results of this investigation, which was carried on in cooperation with the Fixed Nitrogen Research Laboratory, is now being prepared for publication.

In the routine laboratory work a great many samples have been examined with reference to the possibility of utilizing the materials as sources of fertilizer.

# REPORT OF THE ENTOMOLOGIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
*Washington, D. C., August 28, 1923.*

SIR: I submit herewith a report of the work of the Bureau of Entomology for the fiscal year ended June 30, 1923.

L. O. HOWARD,
*Entomologist and Chief of Bureau.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## DECIDUOUS FRUIT INSECT INVESTIGATIONS.

Investigations of deciduous fruit insects have been carried out under the direction of Dr. A. L. Quaintance, as formerly.

THE JAPANESE BEETLE.—Work against the Japanese beetle in cooperation with the Federal Horticultural Board and the New Jersey and Pennsylvania State Departments of Agriculture has been vigorously prosecuted. It is subdivided into the following sections: Administration, quarantine enforcement, biologic investigations, beetle insecticide investigations, grub insecticide investigations, and field work. The regulations established in Federal Quarantine 48, as well as the restrictions of the quarantine laws of Pennsylvania and New Jersey, have been enforced during the year. Something over 483,000 baskets of corn were inspected during the summer and fall of 1922, and many thousands of beetles were removed from the corn before shipping certificates were given. A large amount of inspection of nursery, ornamental, and greenhouse products has been done and certificates issued when the owner was entitled to them. Scouting to determine limits of infestation has been carried out as heretofore and reveals a constant natural spread of the beetle which can not be prevented. Thus at the beginning of the season of 1922 the infested area covered some 270 square miles, while at the close of that season it had spread to over 770 square miles, representing a spread of about 200 per cent.

Much additional information has been accumulated on the biology of the insect and also on its behavior under varying environmental conditions. The relationship existing between common farm practices in the community and grub infestation has also been carefully studied, and it appears that present farm practices are favorable to the insect. Certain modifications appear desirable from the standpoint of control of the beetle, such as extremely late fall plowing and late spring plowing, which tend to reduce the number of grubs.

One of the principal activities under this heading has to do with the importation of foreign parasites. Several shipments of beneficial

parasites have been received during the year from Japan, Korea, and Hawaii. Colonies of a few species have been released in the field and there is good reason to believe that some, at least, may be able to establish themselves. Abroad the work is being conducted from Yokohama, with substations at Koiwai in northern Hondo, Sapporo in Hokkaido, and Suigen, Korea. A species of Tiphia has been collected and reared at Koiwai and a shipment of 2,100 cocoons was dispatched to Riverton, N. J., in October, where they arrived in good condition. Around Yokohama a tachinid, *Ochromeigenia ormioides*, has been found attacking the adult Japanese beetle, and a sizable shipment of this species to New Jersey was made during June. From the region of Sapporo a tachinid, *Centeter cinerea*, parasitic on the adult beetle, has been collected in numbers and carefully studied. A large shipment of this species was sent to New Jersey in October, 1922, and beetles bearing eggs were found there the present summer, indicating that the species has gained a foothold. Another parasite, a dexiid fly, was collected and material bred in some quantity at Koiwai and a shipment made to Riverton in October. It is too soon to say whether this species has become established. A dexiid from Korea is also under investigation and after further study may prove to be a valuable parasite of the beetle. In addition to the above a Tiphia from Korea gives promise of considerable value, as it occurs in the spring of the year and thus supplements a fall species from northern Japan.

Enlargement of the foreign parasite work has been effected. Two more experienced agents have been employed and are now in the Orient, bringing the number of agents to four. The bureau is fortunate to have the active cooperation of Japanese entomologists in this work, which has added greatly to its effectiveness. A search for parasites will be undertaken in China and India, where species of the genus Popillia are numerous. In addition to the material coming from Japan, a large shipment of the wasp *Scolia manilae* was made from Hawaii into New Jersey, but it is doubtful whether this insect will be able to withstand the rigors of this latitude and climate. In this importation work the cooperation of quarantine officials at San Francisco and Seattle, and also of officers of steamship companies and express companies, has been of the greatest value.

In addition to the beetle parasite work in Japan, attention has been given by the agents there to obtaining, if possible, parasites of other insects, such as the oriental fruit moth, citrus white fly, camphor scale, red scale, Citricola scale, etc., and some introductions have been made. The employees at Riverton are carefully investigating the possibility of utilizing native parasites against the Japanese beetle, and studies thus far indicate that but a very small per cent of the insects are destroyed by native forms.

Attention is also being directed to the utilization of possible fungous and bacterial diseases of the Japanese beetle, particularly those attacking the larval stage. Several bacterial diseases have been isolated from dead or dying Japanese beetle grubs and cultures made. From these cultures, tests are in progress to determine to what extent they are pathogenic, by inoculating healthy grubs in the laboratory and the soil in the field. A species of Isaria from France is being cultivated and experiments made to determine its possible value when disseminated in infested pastures and elsewhere.

An extensive study of the feeding habits of the Japanese beetle has been carried on for several seasons and data brought together in a paper on Feeding Habits of the Japanese Beetle which Influence its Control, published as Department Bulletin 1154.

Extensive experiments have been made in replacing the soil ball of coniferous nursery stock with an artificially made ball free from grub infestation to permit the movement of such stock by nurserymen from the infested area. A fair proportion of plants thus handled have come through the second season after such treatment quite satisfactorily, and it is believed that this method gives promise for the use of nurserymen interested in the movement of such stock.

Much attention has been given to the investigation of insecticides for the destruction of the beetles and to kill the grubs in the soil. A fair killing of the beetles was secured from the use of arsenate of lead at the rate of 4 pounds to 50 gallons of water with 2 pounds of flour or casein spreader. One or two applications in most cases were sufficient when applied thoroughly to protect the foliage during the beetle season. Further experiments have pointed out certain improvements in arsenical sprays, which, however, must be subjected to further investigation before definite conclusions are warranted. Many materials have been tried in the hope of finding a substitute for arsenicals for use against the beetle without, however, very much success thus far. Large-scale spraying work has been done in orchards during the beetle season to ascertain the degree of protection from attack which follows different spraying practices. The results show that orchardists can protect their trees and fruit from the beetle by thorough and timely applications of arsenate of lead. Substantial progress has been made in perfecting methods of treatment of infested outdoor-grown nursery stock for the destruction of grubs which may be in the soil around the roots. While no one treatment of universal application has been worked out, several have been developed which are of value under varying conditions.

Methods for the treatment of soil in which infested or noninfested nursery stock may be heeled in have been investigated. Arsenate of lead worked thoroughly into the soil has given rather satisfactory results. Further work, however, must be done before this method is recommended, especially to determine the tolerance of different plants to soil treated with arsenate of lead. The destruction of grubs in infested grass lands, such as golf greens and fairways, can be accomplished, it has been found, by the use of carbon disulphid emulsion. In this way the grub population in sod land can be reduced at a reasonable cost from 60 to 75 per cent.

Grape insects.—Investigations of grape insects in cooperation with the Ohio Agricultural Experiment Station, with headquarters at Sandusky, Ohio, have been continued, special attention being given to the three-banded grape leafhopper, *Erythroneura tricincta*, variety *cymbium*, which seems to be the predominating injurious form in that region. These insects are increasing greatly in abundance, with corresponding injury to vineyards. Careful biologic studies of this and related species are under way, and a preliminary manuscript on the three-banded form has been prepared. Experiments in the control of leafhoppers on grape have been directed toward improving

spray mixtures and apparatus, with the view of reducing cost of treatments. It has been found that the period for most effective control varies considerably with the locality and the species, and that recommendations must be based on seasonal development of the species concerned. Results are now being obtained as to the value of dusting for the control of grape leafhoppers, but further observations will be necessary before final conclusions are warranted. Studies of the hibernating habits of the three-banded leafhopper indicate that a large proportion of the adults remain in the vineyards over winter and congregate on various plants, as dandelions, before grape foliage appears in the spring. Preliminary tests show that a large number of these can be destroyed by the application of proper contact sprays or by other methods. Further information is being secured on the rose chafer, a serious pest of grapes in certain parts of the Ohio and Chautauqua-Erie grape belts. The grape-berry moth continues to cause important injury in some vineyards, and experimental work in its control is under way. It has been determined that where previous spraying has been thorough in vineyards control of the berry moth can be secured by a single spray application made about July 10. At this time the use of a combination spray will also be effective against the grape rootworm and grape leafhoppers.

At the Fresno, Calif., station special attention has been given to determining the value in the control of the grape Phylloxera of paradichlorobenzene. Unfortunately the results secured indicate that this chemical can not be used with success against this insect.

The Achemon sphinx again appeared in large numbers in vineyards at Madera and Livingston during the summer of 1922, and further experiments were made in testing remedies for its control. A report of these experiments was issued in the January-February number of the Monthly Bulletin of the California State Department of Agriculture. Work on the grape mealybug under way at this laboratory for some seasons has been much reduced, owing to the fact that this insect is now being controlled effectively by parasites.

Nut insects.—Investigations of nut insects have been continued as heretofore. Northern nut insects have been studied at the French Creek, W. Va., station and pecan insects at Brownwood, Tex. During the spring of 1923 an additional laboratory for the investigation of pecan insects was established at Thomasville, Ga., in view of the serious depredations to pecans of certain pests in the Southeast.

At the West Virginia station particular attention has been given to weevils attacking chestnuts and other nuts grown in the northern United States. In cooperation with the Bureau of Plant Industry, experiments are under way to determine possible practical methods of control of chestnut weevils, including spraying with arsenicals. Biologic studies of the so-called cambium curculio, *Conotrachelus anaglypticus*, have been completed and a manuscript prepared for publication. This insect, often mistaken for the plum curculio, occurs frequently on peach, to which it does some injury. It is more particularly injurious by mining around wounds in the bark of many kinds of trees, thereby enlarging and preventing the healing of the injury. Investigations at this station are also being made of certain

miscellaneous weevils, as the plum gouger and the apple curculio, both of which are pests of importance to deciduous fruits.

At the Brownwood, Tex., station further attention has been given to the biology of pecan insects injurious in Texas, and several of these have now been fairly well studied. A report on this phase of the work is soon to be issued. In the field special attention has been given to control of the pecan-nut case-bearer and certain other species of prominence. It appears that best control of the pecan-nut case-bearer can be secured by increasing the number of applications of arsenate of lead and timing them with reference to the hatching period of the eggs. The pecan-nut case-bearer and the green stinkbug continue to be seriously injurious to pecans in the Southeastern States. Studies of these insects are being conducted at the Thomasville, Ga., laboratory, and extensive experiments are under way in pecan groves with various remedial measures. Spraying with arsenicals for the pecan-nut case-bearer during early spring when the larvæ are tunneling the young tender shoots has not given encouraging results. Spraying, however, after the nuts have set has yielded more promising results, and it is believed that a satisfactory method of control can be worked out which will call for a carefully timed spray schedule of about three applications. The injury from the stinkbug can be greatly reduced by the elimination as much as possible of cowpeas in the orchards, substituting as a cover crop the velvet bean. Tests of sprays against the pecan-leaf case-bearer indicate that it can be kept in check by applications of arsenate of lead during the month of August and early September. Tests are being made of the dust method in comparison with spraying in the control of this insect. In cooperation with the South Carolina Agricultural College, studies are being made of the pecan-nut weevil, concerning which complaint has been received from points in that State.

Peach insects.—The curculio suppression campaign, started in Georgia in 1920, after this pest had caused a loss of over $2,000,000 to peach growers in that State, has been continued. Beneficial results of the work are being clearly reflected in the yearly increasing quality of the fruit. It was ascertained that a second brood of larvæ of the curculio was during certain seasons responsible for much of the injury to ripening fruit. In cooperation with the Bureau of Plant Industry of this department and the Georgia State Board of Entomology, much experimental work in the field has been accomplished which has resulted in a revision of the spraying and dusting schedule recommended for peaches in Georgia. The treatment now developed is effective in largely preventing injury from the first and second broods of larvæ of the curculio, and also in controlling brown rot and peach scab. The Georgia growers have to an unusual extent followed the directions of the department, with consequent improvement of the crop grown. Tests of the value of spraying or dusting for the control of the curculio after the crop has been harvested have been continued and the results brought together in a manuscript on "Dusting and Spraying Peach Trees after Harvest for Control of the Plum Curculio." It is shown that during periods of unusual curculio abundance this method is an important adjunct in reducing the insect. Attention has been given to ascertaining the value of picking up and destroying peach drops in connection with

the curculio campaign. It has been found that by carefully picking up wormy peaches from under the trees for a period of three to four weeks, a saving of fruit can be effected which, after deducting the cost of the work, amounts to about $50 per thousand trees. In addition to the saving on the current crop the beneficial results of the work accumulate from season to season. Knowledge of the life history of the plum curculio in Georgia is now very complete and the results of studies of this subject will soon be prepared for publication.

Further tests of paradichlorobenzene for the control of the peach borer indicate that this chemical may be used on peach trees 3 years of age and over without injury to the trees. This materially extends the range of usefulness of this product, which has heretofore been recommended for trees 5 years of age and over.

The good results obtained from the use of lubricating-oil emulsion in the control of the San Jose scale on apple in the Ozarks and elsewhere led to tests of the oil in the control of this pest on peach, in comparison with other standard scale treatments. To date no injury to the trees has been discerned, but further observations will be required before the lubricating-oil emulsion can be recommended for the control of this scale on peach.

Apple insects.—The work at the Bentonville, Ark., laboratory has been directed largely toward further tests and improvements of lubricating-oil emulsion for the control of the San Jose scale, as this pest continues to be a serious menace to orchards of that section. This oil emulsion has already come into large use in the commercial apple orchards of the Ozarks without any evidence thus far of injury to the trees treated, and has proved to be eminently satisfactory in destroying the insect when applied during the dormant season. Some attention has also been given to the codling moth to round out work already done as a basis for a bulletin on the control of this insect under conditions in that region. Large-scale experimental spraying work was undertaken in the Arkansas Valley at Wichita, Kans., in cooperation with the Kansas Agricultural Experiment Station. Unfavorable weather conditions have greatly interfered with the prosecution of this work. In the Ozark region certain leafhoppers are injurious to apples to an unusual extent, and these have been under investigation for the past two or three years. Sufficient data have been accumulated on these leafhoppers to warrant the preparation of a manuscript for publication. This will include careful biologic studies and methods of control in orchards.

At the Yakima, Wash., station, codling moth investigations have been continued, and special attention has been given to obtaining information on various practical points, as the value of spreaders or stickers, comparative efficiency of spray guns and spray rods, and especially to further perfecting a spraying schedule for the control of this insect under conditions in the Yakima Valley. In addition to arsenate of lead, other arsenicals have been tested, as calcium arsenate, zinc arsenite, etc. A manuscript on the life history of the codling moth in the Yakima Valley is now in course of publication and a Farmers' Bulletin on the control of the insect in the Pacific Northwest has been submitted, which when published will be of much value to the orchardists of the territory mentioned.

The increasing importance of the European red spider, *Paratetranychus pilosus*, has rendered necessary a careful study of this pest. The biology of the mite is being carefully investigated and experiments made in orchards with various sprays for its control. Indications are that a weak lubricating-oil emulsion will prove satisfactory in killing both the eggs and the mites, with little or no injury to the trees or foliage. The lubricating-oil emulsion has also been tested against the San Jose scale and the wintering eggs of the red spider and has proved very effective. A study of a treehopper causing considerable injury to apple by depositing eggs in the twigs has been started.

At the Wallingford, Conn., laboratory the investigations under way for some years in cooperation with the Connecticut Agricultural Experiment Station on the apple maggot were concluded during the fall of 1922, and a report has been prepared giving the results of the studies. It was determined that satisfactory control of the apple maggot can be secured if the fruit and foliage are coated with arsenate of lead during July and August, the period during which the greater number of the eggs are laid. Since this treatment is to kill the adult flies, which travel rather freely from tree to tree, it is important not only that all parts of a given orchard should be treated but also that the orchards in the neighborhood should be properly sprayed. The apple thorn skeletonizer, which has become a serious defoliator of apple in portions of eastern New York and in Connecticut, has been investigated, and a joint bulletin on the insect has been published from the Connecticut Agricultural Experiment Station. Certain other miscellaneous insects have received attention, as the red-banded leaf-roller, false apple red-bug, apple tent caterpillar, etc.

Beginning in the spring of 1923, a deciduous-fruit insect laboratory was established in southern Indiana in cooperation with the Purdue University Agricultural Experiment Station, with headquarters at Vincennes. At this station will be studied the various fruit insects of importance in this rapidly developing fruit region, such as the San Jose scale, the codling moth, the peach borer, a thrips injuring peaches, etc.

Insecticide investigations.—Investigations of miscellaneous insecticides have been continued at the laboratories in Washington and the near-by field station at Sligo, Md. Studies under way on the chemical, physical, and insecticidal properties of arsenicals, conducted in cooperation with the Bureau of Chemistry, have been concluded and a report on the work published. In cooperation with the Bureau of Plant Industry, a report has been prepared on various plants tested as to insecticidal constituents. The experiments on the effects on honeybees of spraying fruit trees during blossom and as the petals fall have been completed and a manuscript submitted for publication. It is shown that spraying orchards as recommended by entomologists does not result in poisoning bees to any extent. A thoroughgoing study of materials attractive to and repellent to insects has been undertaken, but this work has not proceeded far enough to warrant specific statements as to results.

In the tests of contact insecticides a considerable amount of data has been gathered on various insecticides of this type. In cooperation with the Bureau of Chemistry, material progress has been

made in the development of an insecticide of the general character of nicotine for the control of soft-bodied insects, such as plant-lice. Many compounds are being tested as to their possible toxicity against insects, a partial report of which work has been issued as Department Bulletin 1160. Additional reports on these studies will be made from time to time as the material warrants. In cooperation with the Chemical Warfare Service of the War Department and the scientists of the Federal Horticultural Board, studies are being made of war gases as to their suitability for insect control. At the Sligo, Md., laboratory principal attention is being given to detailed studies of lubricating-oil emulsions at various strengths and for various insects. At this station are also being tested in a field way various insecticidal materials developed by the laboratories in Washington, including many organic substances, chlorinated compounds, coal-tar derivatives and the like.

Taxonomic work.—The taxonomic work of the office relates mostly to Aphididae and Aleyrodidae and involves determinations of insects of these families received from various sources. Four-hundred seventy-five lots of aphids have been handled and 183 lots of aleyrodids. In order to better understand the species described by various workers in foreign countries, specimens of such species as possible have been borrowed and carefully studied and illustrated. Two specialists in Aphididae visited the office during the fiscal year to avail themselves of the bureau collection. A monograph of the genus Amphorophora has been prepared and work is now in progress on the genus Myzus.

## WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

This work has been continued throughout the year under the direction of A. F. Burgess.

The field work of the bureau has been carried on in New England in an area about 25 miles wide adjoining the outside border of the infestation. This strip extends through western Connecticut and Massachusetts and central Vermont, and in the northern part of the last State it swings to the eastward and crosses the State of New Hampshire.

In addition to this, cooperative work was carried on with the State of New Jersey from funds made available jointly by the State and the bureau. The infested area covers about 400 square miles and intensive clean-up work was done in this district.

A fund of $150,000 was made available in New York State early in the spring to carry on survey, experimental, and control work.

The New England States take care of the infestations inside the border area, and this work is paid for from State, municipal, and local funds.

The Federal funds have been allotted to four principal projects, viz, supervision, field and laboratory research, quarantine and inspection, and scouting and extermination work. Each will be considered separately.

Administration.—A central office has been maintained at Melrose Highlands, Mass., from which the work is administered throughout the New England States, eastern New York, and New Jersey. A quarantine office is maintained in Boston, Mass., and a suboffice in

Somerville, N. J. The latter is carried on in cooperation with the New Jersey Department of Agriculture, and the gipsy moth field work in that State is administered from it. A laboratory and small storehouse is located at Melrose Highlands, and a large storehouse for housing field equipment and supplies and making repairs on motor vehicles and tools used in field work has been maintained at Franklin, N. H., but has recently been moved to Pittsfield, Mass.

A small storehouse is also maintained at Bound Brook, N. J., in cooperation with that State, where equipment is stored and repairs made.

FIELD AND LABORATORY RESEARCH WORK.—The laboratory at Melrose Highlands, Mass., is headquarters for many lines of experimental work which is conducted in many sections of the area infested with the gipsy moth, and a temporary laboratory is maintained at Somerville, N. J., during the summer.

Two entomologists from the Melrose Highlands laboratory have been carrying on extensive work in Europe during the past year and another has conducted investigations in Japan. The purpose of this work is to study the conditions in the native home of the gipsy moth and secure as much information as possible concerning the natural agencies that assist in its control. Careful search has been made for parasites and natural enemies of the gipsy moth, and several shipments of promising species have been collected and sent to this country for breeding and colonization. The importance of this project can not be overestimated, as it is desired to utilize every enemy of the gipsy moth that can be secured.

During previous years species attacking the eggs, the larvæ, and the pupæ of the gipsy moth and the brown-tail moth have been secured and colonization of these species has been continued systematically throughout the year.

*Anastatus bifasciatus* has been colonized in all the New England States, 934,000 specimens having been liberated during the fiscal year, and 1,800,000 specimens of *Schedius kuvanae* have also been colonized. These two parasites attack the eggs of the gipsy moth. Twenty-six thousand five hundred and eighty specimens of *Apanteles melanoscelus*, a parasite that attacks the caterpillars of the gipsy moth, were colonized at different points in New England and in New Jersey, and 14,620 puparia of *Blepharipa scutellata* were liberated in Vermont, Connecticut, New Jersey, on Long Island, and at other points in New York State. Field collections of gipsy moth eggs taken from different sections of the infested territory indicate that the parasitism by *Anastatus bifasciatus* averaged from 25 to 30 per cent and in some cases the parasitism by *Schedius kuvanae* ranged as high as 48 per cent. The former parasite survived well in the northern part of the territory, but the latter is not usually abundant in territory much farther north than Boston. In some cases parasitism by *Apanteles melanoscelus* was rather heavy. This was particularly true concerning the second brood of this parasite. Collections of native larvæ in the outside territory indicated that *Compsilura concinnata* had spread as far west as Danbury, Conn., and Milton and Mechanicsville, N. Y. The degree of parasitism by this species in the inside territory was quite similiar to that of the previous year. Collections showed that parasitism

by *Blepharipa scutellata* was very heavy in the northern part of the infested territory, particularly at certain points in New Hampshire, west of the Connecticut River. While this insect was recovered, it did not occur in as great abundance in the southern part of the infested region.

Parasitism of the small caterpillars that hibernate in the brown-tail moth webs was slightly greater than last year, and the larvæ this spring were rather heavily parasitized by *Compsilura concinnata.*

The Calosoma bettle and its larva have been reported very abundant, particularly in sections where gipsy moth and brown-tail moth infestations have been heavy, and in such localities the wilt disease has attacked the large larvæ and pupæ and caused heavy mortality.

Careful study of the biology and habits of the different enemies has been undertaken and many new and important facts of scientific importance have been discovered. Some of this information has already been published in bulletins, but further work is required to secure complete data on many phases of the parasite investigations.

Data have been secured for a series of years to determine the effect of defoliation on different species of trees growing under varying conditions. The record of mortality of trees under observation has been made and the retardation of growth due to periodic defoliation is being obtained. This information will be extremely useful as soon as this investigation is complete. Experiments of importance to all phases of the gipsy moth project and some that have a broader application along the line of insect control are under way.

Tests designed to secure more effective methods of control work in the field have been conducted. Aircraft of the heavier and lighter than air types have been tested for dusting infested forests, in cooperation with the United States Air Service, but this work has not yet proceeded beyond the experimental stage. Some experiments have been made with adhesive materials for the purpose of preventing poisoned sprays from washing from the foliage during wet weather.

The application of the results of this experimental work is bound to have a far-reaching effect on gipsy moth control in the future.

Quarantine and inspection work.—The area infested with the gipsy moth and the brown-tail moth has been placed under quarantine by the Federal Horticultural Board.

Products likely to carry these insects must be inspected before they can proceed out of the infested area. State quarantines regulate the intrastate movement of such products.

During the year 56,799 shipments have been inspected and certified. The number shows a marked increase over that of the previous year.

Scouting and extermination work.—The scouting work was carried on during the past year under extreme difficulty. The supply of experienced men was very limited, and it was necessary to train a large force for work in New England and New Jersey. The volume of the work was curtailed in New England on account of heavy snowfall in December, so that much of the scouting in Vermont had to be discontinued earlier than usual.

After the 1st of January snow conditions became bad in Massachusetts and the northern part of Connecticut. In fact, southern Connecticut was the only region in New England where field work could be done to advantage. Certain sections that could not be scouted in the winter were finished early in the spring, and most of the work was completed as planned, except in Vermont.

As a result of this work the following number of towns were added to the area quarantined for the gipsy moth: New Hampshire, 12; Vermont, 33; Connecticut, 9. Three towns in Vermont were dropped from quarantined areas as no infestation was found. Total increase for the year, 51 towns.

Scouting for the brown-tail moth was carried on along the infested border in Maine and New Hampshire by a few men specially detailed for that work. As a result of the inspections made, 2 towns in Maine and 13 in New Hampshire were added to the area quarantined for this insect. Eight towns in Maine were examined and no infestation found and they were released from quarantine. Total increase in area, 5 towns.

The scouting work in New Jersey proceeded about as planned. In addition, 395 acres of tree growth in a number of river valleys and along the Raritan Canal were either cut or thinned. Many of the trees were defective and furnished such convenient hiding places for egg clusters of the gipsy moth that it was necessary to eliminate them in order to insure thorough clean-up work.

The results of the scouting were very encouraging. Fewer colonies were found than during the preceding year, and in large portions of the outlying area no trace of the insect was discovered. In the area north of Somerville, known as the Watchung ranges, small colonies were located in the woodland. This is the most difficult section in which to do thorough work, and intensive spraying operations were conducted during June. All known infestations were sprayed, and owing to favorable weather the work was very effective. The labor supply was very scarce, however, and it was difficult to secure a sufficient number of men to carry through the spraying work. This made the work more difficult to manage and more expensive than usual.

All colonies found in the area scouted in New England were either banded or sprayed during the spring.

General summary of conditions.—In the territory generally infested with the gipsy moth the area defoliated has been much less than in previous years.

A number of towns have suffered severely, particularly in southeastern Massachusetts and in an extensive area west of Fitchburg, Mass., and throughout several groups of towns west of the Merrimack River in New Hampshire. Defoliated areas of considerable size were also reported near Lake Winnepesaukee, N. H.

The improvement in conditions in the wooded areas was due to considerable nonhatch of the egg clusters above the snowline in many sections and to the increase in the effectiveness of imported natural enemies and disease. The records at the gipsy-moth laboratory indicate that natural enemies have been more numerous and more benefit has resulted from their work than during any previous year.

The brown-tail moth infestation was slightly more severe than during the previous year, and scattering winter webs were found in

the outlying sections of the infested area. In certain sections along the seacoast area in New Hampshire and in the Merrimack Valley considerable defoliation was caused by this insect.

A high percentage of parasitism was found in all localities where sample collections were made, and in a few places the brown-tail moth fungus was present and destroyed large numbers of the full-grown caterpillars.

The gipsy-moth work in New Jersey has been carried through in cooperation with that State and excellent results have been secured. The number of localities where infestations have been found is less than during the previous year and the area infested has been materially reduced.

In New England weather conditions immediately following the hatching period this year were not favorable for the spread of the gipsy moth to new territory. Plans have been made for a thorough scouting of the Hudson Valley by the State of New York, and an additional area between this strip and the infested territory in New England will be inspected by the bureau. From the information secured from this work it will be possible to determine the most favorable area in which to locate a barrier zone against spread toward the west between Long Island Sound and the Canadian border.

## CEREAL AND FORAGE INSECT INVESTIGATIONS.

W. R. Walton has continued in the leadership of this section of the bureau's work.

EUROPEAN CORN BORER.—There have been no developments of great importance in the European corn-borer situation during the past year. The extent of the infestation in northwestern Pennsylvania, northern Ohio, and southeastern Michigan has remained substantially as reported at the corresponding season last year. In the areas mentioned a slight spread into contiguous territory has been noted, but the intensity of infestation in these regions has not increased materially and amounts on the average to about 1 and not to exceed 3 per cent of the corn plants grown within the areas. The highest infestation noted was in the immediate neighborhood of Ashtabula, Ohio. As yet, the insect has done no perceptible damage throughout this region.

As noted in the last report, a field laboratory has been located at Sandusky, Ohio, where investigations are being carried on in cooperation with the Ohio State Experiment Station for the purpose of collecting seasonal biological data, determining the most immediately effective measures for control, and the varieties of corn best suited for culture in that region under conditions of corn-borer infestation.

In the area of infestation immediately surrounding Buffalo, N. Y., a very considerable spread eastward was noted during the summer and fall of 1922. This has been largely in the direction of the prevailing winds, and probably was due to the migration of moths either from the Canadian area or perhaps from the Indian reservation which forms a part of the American area of infestation, and where it has not been possible to induce the corn growers to make any effort to control the pest. Although this area of infestation has increased materially in extent, the amount of damage inflicted has been com-

paratively slight. In eastern New York, in the vicinity of Schenectady and Albany, the area has grown slightly, but the damage here continues to be trifling.

Scouting operations conducted throughout the New England area during the summer of 1922 developed the fact that the corn borer had invaded eastern Rhode Island and had spread northwestward up the Merrimack Valley into central New Hampshire. It has also become firmly established in York County, Me. It is believed that the insect probably has reached its limit of destructive distribution in central New Hampshire, as practically no corn is grown to the northward of the present area, which is bordered by the White Mountains. On the other hand, it is probable that the insect will continue to spread into southwestern Maine, and that it may seriously invade the sweet-corn growing area adjoining the region of present infestation. The pest continues to be seriously injurious in the region immediately surrounding Boston, Mass.

During the year a new publication, Farmers' Bulletin 1294, has been published, embodying the immediately applicable results of the European corn borer investigations which have been carried on for the past four years. A complete technical report on the progress of these investigations is in preparation.

Excellent progress has been made in the work of introducing the insect enemies of the corn borer from Europe, and during 1922 more than a million specimens of one species were liberated in the New England area.

Arrangements have been perfected with the Canadian Department of Agriculture to supply colonies of this parasite for possible establishment in the Dominion in southern Ontario, where the corn borer occupies a large part of the peninsula bordered by Lakes Ontario, Erie, and Huron. An additional parasitic species which first was liberated in Massachusetts during the fall of 1922 has been recovered from the field in several different localities in New England, and the establishment of this species there now seems assured. Several other promising parasites are being reared, both in New England and in France, and it is confidently expected that these species will be propagated in sufficient numbers to insure them an excellent opportunity to become established in this country.

Some of the States which have been cooperating financially in the work against the European corn borer have failed to appropriate funds for the continuation of this work during the present fiscal year, a fact which may interfere somewhat with the effectiveness of the combat against this pest. An additional appropriation of $25,000 which was granted by Congress and which became available July 1, 1923, will not be entirely sufficient to compensate for the reduction of State assistance in this work.

Alfalfa weevil.—The continued spread of the alfalfa weevil throughout the Great Basin States and the increasing damage which it is causing in some of these States, notably Idaho, have caused great apprehension, especially throughout the more newly infested regions. The insect now occupies practically all the alfalfa-growing regions of Utah and Idaho, and is found in parts of Colorado, Wyoming, and Nevada. It has also been discovered in eastern Oregon and more recently has been reported from Sierra County,

Calif. An efficient means of control has been evolved by the bureau in the use of an arsenate of lead spray which usually gives satisfactory control when applied once during the season. In southwestern Idaho, however, it was discovered that two sprayings are necessary in order to obtain satisfactory control, because of the fact that the weevil continues laying eggs throughout a longer period than elsewhere. The one thing which apparently is most urgently needed in the aid of artificial control of this pest is some more efficient means of placing the available information on control before the alfalfa growers who are most vitally concerned. Some of the States which have been carrying on this educational work have been compelled to restrict or discontinue it through lack of funds. This has been the case notably in Idaho, and it is hoped that some means may be found for the continuation and elaboration of this type of work in connection with alfalfa weevil control.

Arrangements have been perfected for resuming the introduction of the insect parasites of the alfalfa weevil from Europe. An expert who was dispatched to France for that purpose more than a year ago recently has returned after accomplishing his mission, and shipments of parasitic material are beginning to arrive in this country. It is hoped by these means to supplement the good work of a parasite already introduced from France, and thus eventually to restore the balance of nature and secure natural control.

Grasshoppers.—Grasshoppers have continued to be seriously injurious in the spring wheat region of the Northwest, and especially severe outbreaks have occurred in northern Montana and throughout Wyoming. Local outbreaks of these and similar insects have occurred in eastern Utah and northwestern Colorado, where the bureau has been active in lending its aid through the services of a corps of trained experts, whose headquarters have been located at Billings, Mont. Progress has been made in the standardization of the poisoned baits and in the coordination of the plans for control between the various State agencies and the entomological workers of the Dominion of Canada in the neighboring prairie provinces. It is estimated that campaigns in which the bureau has assisted in North Dakota, Montana, and Wyoming have resulted in the saving of about 10 per cent of the wheat crop throughout the areas involved.

A serious outbreak of the lubber grasshopper occurred in west-central Texas during the summer of 1923, during which considerable damage was done. The farmers found it difficult to poison because of the suddenness of the attack and the fact that sufficient arsenic was not locally available.

A serious and widespread outbreak of grasshoppers occurred in the Klamath Lake region on the southern border of Oregon and the northern edge of California. Experts of this bureau were dispatched from Sacramento, Calif., and Forest Grove, Oreg., to assist the local authorities in securing control. A very considerable saving of crops resulted from the work done. If this pest is to be permanently controlled, however, a thorough study of the whole problem will be necessary, and because of the fact that this problem is of an interstate character and involves public lands within the breeding grounds of the pest, it seems proper that the Federal Government should initiate studies looking toward the control of grasshoppers in this severely infested region.

THE SOUTHERN CORN STALK-BORER.—This insect, which is closely related to the larger corn stalk-borer and the sugar-cane moth borer of the Southeastern and Southern States, has become increasingly injurious and abundant during the past two years throughout the Big Bend country of Texas and the river valleys of eastern New Mexico. Investigations have shown that the counties of El Paso, Culberson, Jeff Davis, Presidio, and Brewster, in Texas, are most seriously involved. The pest has been reported as so abundant and destructive in the Pecos Valley as to cause the growing of corn to be practically discontinued there. The species apparently is of tropical origin, but has been found to occur at elevations exceeding 5,000 feet. The eastern edge of the infestation in northwestern Texas is separated from the western border of the corn-growing area of the State by a strip of land about 25 miles wide, in which no farming is done. As this species evidently is a highland form and similar in that respect to the Colorado potato beetle and the Mexican bean beetle, it seems altogether possible that it has potentialities for damage throughout the Corn Belt which may prove formidable, should it migrate to that region. A close study of the species, therefore, is being made.

WHEAT STRAWWORM.—The wheat strawworm is distributed throughout the wheat-growing regions of the United States, and ranks high in importance as an insect enemy of wheat, often destroying whole fields of this crop, especially in the spring wheat region. As a result of studies carried on during the past few years, with Charlottesville, Va., as a center, it has become possible to publish during the past few months a brief Farmers' Bulletin, No. 1323, which affords practical information regarding the control of the pest.

OTHER INSECTS.—A number of other projects are under way. The corn earworm, which is the same insect as the cotton bollworm and the tomato fruitworm, is from the fact of its many food plants a most difficult insect to control. Possibilities of cultural methods are being studied under this section and a cultural means of control discovered has proved satisfactory in the Atlantic coastal plain region. The webworms, which normally inhabit grasslands, frequently damage corn to a serious extent when grasslands are broken up and planted to corn. Studies of these insects have been continued with measurable success in the region of which Knoxville, Tenn., is the center.

## STORED-PRODUCT INSECT INVESTIGATIONS.

Investigations in this section of the bureau work have continued under the leadership of Dr. E. A. Back.

BEAN WEEVIL INVESTIGATIONS.—The biological studies of the bean weevils, *Bruchus obtectus* and *Bruchus quadrimaculatus*, which have had the leading place in the investigation work being conducted with headquarters at Alhambra, Calif., have been subordinated during the past year to a study of these pests in the commercial bean fields of California. Studies of the varietal susceptibility of the commercial bean varieties have been continued along with a more intensive study of the possibility of controlling field infestations by the proper timing of planting and harvesting and the intelligent use of trap crops.

Special attention has been given to a study of the handling and storage of beans and peas in commercial bean warehouses with a view not only to eliminating infestations once crops have been gathered but to determining the connection between careless and unintelligent warehouse methods and the increasing difficulty of growing crops of beans free from infestation. Satisfactory progress is being made, and this work of the bureau has received the commendation of the California Bean Growers' Association and the bean weevil committee of the Modesto (Calif.) Chamber of Commerce.

INSECTS ATTACKING GRAIN AND GRAIN PRODUCTS.—The investigation of insects attacking corn, wheat, and other grains and mill products has been continued during the past year at Washington and at Thomasville, Ga.

At Washington studies of the biology of the rice weevil, *Sitophilus oryza*, and the granary weevil, *Sitophilus granarius*, have been finished for the present and the results prepared for publication. Studies of the biology of the cadelle, *Tenebroides mauritanicus*, and the mealworms, *Tenebrio obscurus* and *Tenebrio molitor*, are nearing completion and the data are being prepared for publication. A study of the biology of other grain pests, more particularly the flour beetles, *Tribolium* spp., is under way.

In southern Georgia, with headquarters at Thomasville, the work reported upon last year has been continued with good results. Special studies have been made during the past year of the relationship existing between the location of cribs and other storage centers and the degree of infestation in other parts of the field. While these studies are far from complete, the data already secured indicate that there is a good basis for the belief that the migrations of the rice weevil from storage centers are responsible for much if not all of the widespread and potentially serious infestation found in the field in corn at the time of harvest. This is a continuing work and will require more funds before it can be determined whether field infestations can be controlled by community effort in the destruction of insects in storage.

DRIED FRUIT INSECTS.—Intensive studies have been made at Fresno, Calif., of the Indian-meal moth, *Plodia interpunctella*, and of the dried-fruit beetle, *Carpophilus hemipterus*, two serious pests of dried fruit, and data concerning their biology are being prepared for publication.

INSECTS ATTACKING MEAT.—The investigation of insects attacking meats, particularly cured meats, begun two years ago, was interrupted June 30 for lack of sufficient funds. Good progress has been made during the past year and many new scientific data secured. Technical papers summarizing these data have been prepared on the cheese and ham skipper, *Piophilus casei;* the red-legged ham beetle, *Necrobia rufipes;* and the larder beetle, *Dermestes vulpinus.*

FABRIC AND HOUSEHOLD PESTS.—The investigation of fabric pests has been conducted at Washington and has centered in a study of the biology of the clothes moth *Tinola biselliella* and the carpet beetles *Anthrenus fasciatus* and *Attagenus piceus*, together with numerous tests made of cloths that have received so-called moth-proofing treatments, in cooperation with fabric concerns and the

Insecticide and Fungicide Board. It is natural that this phase of the bureau's work should be specially active during a year when the interest of the fabric industry of the country has been aroused by the possibility of rendering woolen fabrics immune to clothes moth attack. Farmers' Bulletin 1353, Clothes Moths and Their Control, and Farmers' Bulletin 1346, Carpet Beetles and Their Control, are in course of publication, and data on the biology of *Tineola biselliella*, *Anthrenus fasciatus*, and *Attagenus piceus* are being prepared.

Cold storage for the prevention of loss by insects.—The aim of this investigation is to determine the most practical temperature at which commodities subject to insect destruction in storage can be held to render them free from living pests. Four cold storage units have been secured for laboratory tests. Data are accumulating in the bureau files which will be supplemented by others secured in commercial storage plants. The rapid increase in the use of cold storage for the preservation of commodities has opened a new and most practical field for investigation. At present the demands for information concerning the effect of cold storage temperatures on the insects in stored commodities can not be met for lack of data.

Experiments with woods of insecticidal value.—The completion of experiments to determine the value of cedar chests made of the red cedar, *Juniperus virginiana*, reported upon last year, has led manufacturers to inquire concerning the possible value of other woods when made into chests and closets, from the standpoint of moth protection. Woods of the southern or white cedar, the redwood, and camphor are being tested. Woods of the Spanish cedar, *Cedrela odorata*, and Port Orford cedar will be tested. The possible value of the essential oils of these woods as well as those of the eucalyptus and pine when used to impregnate wardrobe linings in which fabrics are stored is being tested.

Fumigation.—The investigation of the value of fumigation in the prevention of losses through insect attack in warehouses continues to be an important phase of the work of the bureau. Industries throughout the country are calling upon the department continually for information regarding the protection by fumigation of stocks of raw wool, grain, grain products, beans, cowpeas, candies, meats, hides, brushes, fabrics, furniture, and a long array of other susceptible raw and manufactured products.

Inspection and intelligence service.—Cooperation with the Army and Navy has been continued in the way indicated in last year's report. This service during the past year has been directed more largely toward furnishing the Navy with information regarding the protection of large consignments of brushes, flags, sweaters, and other wearing apparel from moth attack.

## TROPICAL AND SUBTROPICAL FRUIT INSECTS.

Investigations of tropical and subtropical fruit insects have been carried out under the direction of Dr. A. L. Quaintance as formerly.

Citrus fruit insects.—At the Florida citrus insect laboratory at Orlando special attention has been given to the so-called Bordeaux-oil-emulsion spray for use in preventing damage by citrus insects and

diseases. This work, carried out in cooperation with the Bureau of Plant Industry, has been successful and the results have been brought together for a publication on the subject. Two new oil emulsions have been tested which give much promise as treatments not only for insects attacking citrus, but also for those attacking deciduous trees. Experiments in the use of dusts for the control of the orange rust mite have been completed and the results have been published in the local horticultural press. A paper giving results of several years' study of the rust mite is in course of preparation and will prove of much value to citrus growers. Further data on the biology of the Florida red scale have been accumulated and it is believed that these studies will soon permit of a complete account of this very important citrus pest.

The continued importance of the citrus thrips in California led to the establishment of a laboratory at Lindsay in cooperation with the Tulare County Citrus Growers' Exchange for a special investigation of this insect. Attention is being given to the biology and ecology of the citrus thrips, and extensive experimental work in the field with various spray materials is being done to test their relative efficacy. Since this station was established in March, 1923, there has not been sufficient time for definite results in the biologic or field experimental work. The indications are that spray materials in general use on citrus will, when applied in the proper manner and at the proper time, be effective in the control of the citrus thrips. Spraying for the thrips, however, must be considered in conjunction with spraying for other insects, such as the Citricola scale. Since the cost of spraying amounts to about $10 to $15 per acre for a single application, and since probably two applications for both scale and thrips control are about the maximum that can profitably be given, special attention will be directed to the development of economical and effective methods for the control of the two pests by one and the same treatment. Further experiments with nicotine dusts for the control of the thrips confirm earlier conclusions that this was not effective.

Fruit flies in Hawaii.—The investigations and control of fruit flies in Hawaii have been continued in cooperation with the Federal Horticultural Board. The plant quarantine regulations of the board require the inspection of fruits and vegetables for shipment to the mainland, and supervision over plantations and packing sheds is maintained. In connection with this work 2,330 shipments of fruits and vegetables for export to the United States have been inspected and 670 packages, mostly bunches of bananas, were rejected as unfit for shipment. The number of packages certified for shipment was as follows: 215,555 bunches of bananas, 11,304 crates of pineapples, 5,659 crates of taro, 389 bags of coconuts, 149 crates of ginger root. As heretofore, daily records of parasitism of the Mediterranean fruit fly, *Ceratitis capitata*, by the four introduced parasites have been made, as well as the amount of infestation by the fruit fly in different host plants. Much progress has been made in the life history studies of three bruchids, *Bruchus prosopis*, *Mylabris sallaei*, and *Caryoborus gonagra*, all of which attack the seed pods of the algaroba, *Prosopis juliflora*. Several parasites attack these bruchids, four species of which were introduced into the island from Texas. These parasites are being

studied with the view to their better utilization. Extensive experiments on the effect of cold-storage temperatures on the fruit fly in fruits have been undertaken. Information of this character will be useful in connection with questions of exports.

Fruit flies, Canal Zone.—Investigations at the Canal Zone station have been directed to obtain further information concerning various subtropical insects likely to be introduced into the States. In cooperation with the Federal Horticultural Board, close scrutiny is maintained to insure, if possible, that no foreign insect effects establishment in the zone as a result of the large amount of traffic from all parts of the world which moves through the canal.

Mango and avocado insects.—Studies of subtropical insects other than citrus insects have been continued at the Miami, Fla., station, special attention being given to the red spider of the avocado, avocado white fly, avocado leaf thrips, papaya fruit fly, and others. The red spider has proved to be a pest of major importance in all sections where avocadoes are grown in Florida. The biology of this mite has been carefully studied as a basis for control operations and a preliminary report has been issued. As a treatment for the mite a mixture of sulphur and dehydrated lime has proved to be superior as a dust to pure sulphur, and obviates danger of occasional burning of foliage under high temperature. Studies of the avocado leaf thrips have been comprehensive and a manuscript on the insect is in the course of preparation. This insect can be well controlled by the use of lime-sulphur, nicotine spray, or a nicotine-soap spray. A nicotine dust is also quite efficient in destroying the thrips. The papaya fruit fly continues to be difficult to control in view of its habit of boring into the fruit. By the use of cloth and paper bags applied at the proper time a large percentage of injury by this insect can be avoided. Several mango insects are also being studied, as the mango shield scale, the blossom Anomala, the tessellated scale, Florida red scale, and the like.

Camphor scale.—Work on the camphor scale, a recent introduction from Japan, is being vigorously prosecuted in cooperation with the Louisiana State Department of Agriculture, with headquarters at New Orleans. This insect is apparently rapidly increasing in New Orleans, where it was first discovered several years ago. It is also present in the wooded country about 15 miles west and in the swamps just north of the city. Two infestations at Hammond and Baton Rouge, La., previously reported, are believed to have been eradicated. The insect has been found in a small citrus nursery at Lake Charles, La., and steps have been taken to eradicate this infestation if possible. In Alabama the insect appears still to be confined to the general region around Grand Bay and to a single citrus orchard in the vicinity of Mobile. The scale has also been found at Alvin, Tex., on the site of an old nursery, from which it is not improbable the insect has been shipped and become established at other points in Texas and perhaps other States. The Texas infestation, however, is not especially intense and the insect apparently is not so successful in maintaining itself in that State as in the more humid region around New Orleans. So far as known no additional infestations in Mississippi have been discovered other than those previously reported, namely, at Hattiesburg, Pass Christian, and Biloxi. The infested plants in every instance were

destroyed and it is likely that under the vigorous system of inspection and treatment practiced in Mississippi no camphor scale now exists in that State.

Special work is being done to develop efficient and economical sprays for the control of the camphor scale on its various host plants. Many tests have been made to ascertain the proper strength of and exposure to hydrocyanic-acid gas for the disinfection of nursery stock shipped out of the New Orleans area. All regulatory and other work designed to prevent the spread of this pest is in the hands of the officials of the various States interested. Special attention is being given to this work by the Louisiana State entomologist in view of the general occurrence of the pest in New Orleans and the amount of florist and nursery stock being shipped out.

Greenhouse insects.—The studies of greenhouse insects under way for some years have been continued and enlarged to meet the demand for information from florists and others concerning insects attacking plants grown under glass. The investigation of the strawberry rootworm, an insect injurious to roses, has been completed and a satisfactory method of control determined, which has been published in Farmers' Bulletin 1344. The insects attacking chrysanthemums have been studied and a publication giving advice on this subject distributed during the spring. Experiments in the control of *Chrysomphalus aonidum* on Kentia, Phoenix, sago palm, and rubber have been carried out, and it has been found that fumigation, using 1 ounce of sodium cyanid per 1,000 cubic feet of space, will give 100 per cent control without injury to the plants, provided the plants are properly shaded before and after fumigation. Tests of many different insecticides on this scale have been made, with the result that lubricating-oil emulsion has proved to be very satisfactory for its control, producing a mortality of 78 per cent. A second treatment with the emulsion however gives a control of approximately 100 per cent. Numerous other important studies are in progress, as experiments in the fumigation of Dutch bulbs; tolerance of plants to hydrocyanic-acid gas; control of earthworms with contact insecticides; liquid cyanid experiments, etc.

## VEGETABLE AND TRUCK-CROP INSECT INVESTIGATIONS.

Work on the project of vegetable and truck-crop insects has been continued as formerly under the direction of Dr. F. H. Chittenden. The Mexican bean beetle and the sweet-potato weevil have been the subjects of special lines of investigation, the former with a view to the discovery of an insecticide which will effectively destroy the insect without at the same time injuring beans and other leguminous crops affected, the latter with special reference to its eradication in Mississippi, Alabama, Georgia, and certain sections of Florida.

The Mexican bean beetle.—The Mexican bean beetle has continued to extend its northward range. A slight extension was noted in Georgia in the counties southeast of Atlanta. The Thomasville infestation has apparently not changed. While it is hoped that such conditions as low altitudes, warm weather, and the absence of mountains are unfavorable for the development of this pest, it is still too early to draw definite conclusions. The extension of infested territory includes two new States—Mississippi (one county) and Virginia (two

counties). The insect has been reported in Meade County, Ky., on the Ohio River opposite Indiana. Throughout the area known to be infested in 1922, the injury has been more or less spotted in intensity. Heavy injury has been reported from growers in areas known to be suffering relatively little as a whole. Numerous requests for assistance have been received from central Kentucky, Virginia, and North Carolina, showing that the insect is attracting greatest attention along the northern edge of the infested territory. Tests with arsenicals and other insecticides are being conducted at the main laboratory in Alabama and at a substation in Tennessee. The combinations which gave the most promise during 1922 are as follows: As a wet spray, 1 pound of magnesium arsenate to 50 gallons of water; as dusts (1) 1 pound of magnesium arsenate to 4 or 5 pounds of air-slaked lime, (2) 1 pound of tricalcium arsenate to 9 pounds of hydrated lime, (3) 1 pound of calcium arsenate, 1 pound of dusting sulphur, 4 parts of hydrated lime. The calcium-arsenate-sulphur-lime dust which was developed by the Alabama Experiment Station has given good results in tests performed by the Bureau of Entomology. During the late summer of 1922 several shipments of *Paradexodes epilachnae* Aldr., a tachinid fly parasite of the bean beetle, were received from Mexico. About 300 individuals were bred from native larvæ of the bean beetle, but most of these issued and died in the late fall after the bean beetle had stopped breeding. An agent of the bureau is now in Guatemala and Mexico searching for additional parasites of the bean beetle. It is planned to make additional shipments of this parasite in an endeavor to bring about its establishment in the southeastern United States.

Other insects injurious to peas and beans.—Work on the pea aphis has been continued on cannery peas in both Wisconsin and California. Experiments with nicotine dust, using both the ready-prepared dust and a machine which mixes and applies the dust at one operation, have given some promise. Tests are also being made of calcium cyanid as an open-air fumigant, but have not been completed. Studies on the migration of the aphis and the farm practices in more heavily injured districts are being conducted in cooperation with various State entomologists. Investigations on the control of the bean fly or seed-corn maggot are being continued in New Jersey. Further tests for the control of the bean leaf-beetle and bean aphis are being made. Experiments for the control of the corn earworm, which has attracted unusual attention as a pest of cannery beans, are being conducted in Maryland.

Sweet potato weevil eradication and control.—The sweet potato weevil eradication campaign has been continued successfully in Mississippi, Alabama, Georgia, and portions of Florida. During the early summer inspection no infestations were found in the formerly infested region of Charlton County, Ga., and Baker County, Fla., but several farms with unsatisfactory histories are being closely watched. Thorough inspection in territory surrounding the old infested area has not revealed a single new infestation. The reduction in the number of dangerous farms permits a closer supervision of this territory, and the inspectors have been able to keep close check of infested and suspicious stocks. In the infested area near Lily, Fla., the eradication project has been continued successfully without supplying the growers with clean planting stock. All seed materials

selected by inspectors are taken from farms under supervision and planted in approved fields. This method is preferred by the farmers, since they are not dependent upon outside sources. The final success of this method will be of great importance in proving the direct value of cultural efforts on the part of individual growers. In Alabama a small new infested area was discovered in a fishing settlement on the Gulf of Mexico. This infestation, the only one known in the State, does not immediately threaten the commercial sweet-potato growing areas, but repressive measures are being applied. The number of infestations in Mississippi has increased to some extent during the past year, and insufficient personnel, coupled with high winter temperatures which favor the growth of volunteer sweet potato, is responsible for the increased infestations. In Pearl River County, Miss., the planting of "outlaw" slips is responsible for the extension of the infested area. An interesting occurrence of the year was the discovery of an infestation in Stephens County, Okla. The close cooperation of the State plant boards of Mississippi, Florida, Alabama, and Georgia has continued to facilitate the eradication campaign.

Insects injurious to potato, tomato, and related crops.—Tests for determining the minimum application of various arsenicals for the control of the Colorado potato beetle are being conducted in Louisiana. Attempts to control the tomato suckfly, *Dicyphus separatus* Uhl., in Texas have led to the conclusion that from 3 to 5 applications of a 3 per cent nicotine sulphate dust are required. Further work with improved dusts is planned. Plantings of trap crops of sweet corn for the tomato fruitworm were found to be ineffective in Louisiana. The only promising remedy for this insect consisted in keeping the tomato foliage well covered with arsenicals during the fruiting period, a difficult operation in regions of frequent rains. The Australian tomato weevil, which was recently discovered in southern Mississippi, has been found to be more widely distributed over the Gulf Coast region than had been anticipated. It has been determined to be, in restricted localities, a severe pest on turnips and tomatoes. Investigations are still under way on the potato leafhopper and potato aphis.

Cucurbit insects.—Studies on the striped cucumber beetle are being continued in Wisconsin and Virginia. The value of nicotine dust for the control of this pest has been proved by additional experiments, and at the present time improved dusts are being tested against it in the hope that various combination treatments may be developed. Nicotine dust has also been tested against the melon aphis in Maryland and Texas and it has been found to give a much more satisfactory control than the nicotine soap sprays. The belted cucumber beetle, *Diabrotica balteata* Lec., has been studied in Louisiana, where this insect within the past few years has developed into an important and threatening enemy of beans, cucurbits, and other vegetables.

Insects injurious to cabbage and other cole crops.—Experiments in the control of various insects affecting cabbage and related crops have been conducted in South Carolina and Louisiana. Nicotine dust has been found to control effectively the turnip aphis, *Rhopalosiphum pseudobrassicae*. Insecticide tests are also being conducted against the cabbage aphis and the harlequin cabbage bug.

A study has been conducted on the distribution and habits of the cabbage flea-beetles and some species have been the subject of special investigation in Louisiana. Nicotine dust gives some promise as a control means.

Insects injurious to strawberries.—Investigations in the control of the strawberry weevil have been continued in New Jersey and South Carolina, and in both States the value of proper arsenical combinations with sulphur applications has been demonstrated. In Louisiana additional studies have been conducted in the control of the strawberry flea-beetle, *Haltica litigata* Fall, which has within the past few years become a serious pest on strawberries in that State. Further work is being conducted in the control of the red spider on strawberry in Louisiana. It has been learned that the unfavorable weather conditions existing in the spring render it almost impossible to control this insect at the time when it is in greatest abundance and most injurious to strawberry. Biological studies, however, indicate that it may be possible to obtain practical control by application of insecticides in the fall.

Sugar-beet insects.—Work on the curly-top leafhopper in cooperation with the Bureau of Plant Industry has been continued in southern California. Further studies in the life history of this insect and the relation of wild food plants to its destructive abundance are being followed. The production of disease-resisting strains is still receiving attention and some promising preliminary results have been obtained. Life-history studies of the beet armyworm in its occurrence on peas in California are being continued.

Nicotine dust investigations.—The importance of nicotine dust as a means for the control of various truck-crop insects has led to a continuance of studies of this insecticide. The relation of various carriers to the effectiveness of nicotine dusts is being tested in California, Louisiana, Maryland, Virginia, and Wisconsin. Such tests have considered the mechanical value of different compounds, in addition to their absorptive qualities and the varying rates at which they cause volatilization of the nicotine.

General truck-crop insects.—In South Carolina the Porto Rico mole cricket, recently introduced in that State, has continued to be the subject of investigations with poisoned baits with gratifying success. In Louisiana additional work has been conducted on the southern green plant-bug, *Nezara virídula* L., but a perfectly effective method of control has not yet been developed. Work has been done on the control of the onion thrips in Texas, with especial attention to the value of nicotine dust as a remedy, and additional work has been conducted on the onion maggot in its occurrence in Wisconsin. Some work has been begun and will be continued on dusting with calcium arsenate or arsenate of lime on a number of insects in comparison with other arsenicals and nicotine dust, since it contains a stronger arsenic content than lead arsenate and can be obtained cheaper. As soon as it is on the market more extensively it will probably replace lead arsenate at nearly half the cost. The results thus far obtained are very promising.

## SOUTHERN FIELD-CROP INSECT INVESTIGATIONS.

Dr. W. D. Hunter has been in charge of these investigations as formerly.

COTTON BOLL WEEVIL.—The principal activities have centered around the study and further improvement of the calcium arsenate dusting method of boll-weevil control. Severe weevil infestation in 1922 caused a more extensive commercial use of this method than ever before. A special study was made of the results secured by approximately 1,100 farmers, who dusted altogether 125,485 acres of cotton. These farms were quite uniformly distributed over practically all of the cotton States and represented every type of condition under which dusting was conducted. A summary shows that slightly over 96 per cent were successful in controlling the weevil to the extent of making the operation profitable. The average increase in yield upon these farms was 339 pounds of seed cotton per acre. The average cost of the season's application was $4 per acre.

The increase in the use of calcium arsenate developed a shortage of this material. This resulted in the appointment of a committee from various Federal agencies, such as the Geological Survey, Bureau of Mines, Bureau of Chemistry, and Bureau of Entomology, as well as representatives of producers and consumers of arsenic in various lines, for a thorough study of the calcium arsenate situation. Undoubtedly such broad consideration of all angles of the problem of arsenic supply and demand will do much to stabilize further development and to make supplies available for the farmer as needed.

Special studies have been conducted along the line of determining the minimum yield per acre upon land where dusting with calcium arsenate would be justified by results obtained. Approximately 1,000 tests affording a comparison between cotton upon which weevils had been allowed to propagate without hindrance and other cotton, strictly comparable, but from which the weevils had been practically eliminated by poisoning, were summarized. It has generally been found that the season's dusting upon any particular farm should cost not to exceed the current value of 100 pounds of seed cotton per acre, in order to make a profit by the dusting method. After making all computations in this regard, the recommendation for dusting has been modified to include all lands having a potential yield of over one-third bale per acre and suffering fairly severe weevil infestation.

The plat tests on methods of poisoning at Tallulah, La., have been continued. The study on season of poisoning, with particular reference to comparisons between early and late-season applications, was practically completed, and the results are being put into the form of a bulletin for publication.

The unusual interest in sweetened poisons for weevil control necessitated carrying out large series of tests on this method, and many such preparations were studied. So far the results have not been sufficiently definite to warrant recommending the general use of such preparations by planters, but the studies are being continued in the hope of developing some way in which they can be used to advantage.

The work in developing new types of equipment and improving existing models has been continued. It has been found that as cotton dusting extends to new districts, new problems of application from

the mechanical viewpoint are met, which necessitate either producing new types of machinery or modifying existing types. Probably the most important development of the year along this line has been the further improvement of the saddle dust-gun to the point where it is now a commercial success. Particular attention is also being devoted to the problem of developing dusting machinery which will permit daytime operation.

Chemical studies in cooperation with the Bureau of Chemistry and the Insecticide and Fungicide Board have been enlarged and include not only the improvement of calcium arsenate but also the possibility of finding an even superior chemical for this purpose. One of the most important discoveries of the year was the fact that there is a very distinct chemical relation between the composition of the dew on the cotton plant and the action of certain insecticides. It was found that the dew on cotton plants is strongly alkaline, and this discovery opens up many important possibilities while explaining some apparent inconsistencies in the results of certain chemicals previously studied.

Other correlated problems which have received attention include the electrical charging of poison dust and the classification of insecticides on the basis of physical characteristics.

The invasion of the extreme southeastern States by the weevil brought the species into contact with new conditions which will necessitate some modifications in the problem of control. Therefore investigations in cooperation with the State of South Carolina were inaugurated in a comparatively small way at Eastover and Sumter, S. C., but in the spring of 1923 a more elaborate station was opened at Florence, S. C., at which place an investigation of the entire weevil situation in the southeastern territory was begun. Careful experiments to test the different methods of weevil control advocated by agencies outside of this department as well as the dry calcium arsenate method were started.

The relationship between cotton dusting and aphis injury to the cotton plants was further studied. It was at first thought that the reason for the abundance of aphids was the poisoning of the predatory enemies of this species. Experiments to test this idea have not been conclusive. It has been shown, however, that the cotton aphis can be controlled by the use of nicotine dust with a hydrated lime base used at the rate of 8 or 10 pounds per acre when the dust contains 2 to 3 per cent nicotine. Practically complete control can be secured from a single application.

In the fall of 1922 experiments in the use of airplanes for the purpose of applying insecticide dusts were inaugurated. The airplane applications at that time were for control of the cotton leafworm, but many points were determined which apply to the problem of weevil control.

In the spring of 1923 experiments were started in direct control of the boll weevil by means of airplanes. The results so far have shown quite definitely that airplanes can be used economically to control gross feeding insects such as the leafworm, but it has not been determined as yet that they can be used for boll-weevil control.

Studies on hibernation, together with correlated records on spring emergence and distribution, have been continued and in the spring of 1923 reached the point where it was possible to bring the records

together for publication. A total of nine years' observation at Tallulah have been accumulated, including both annual comparisons and special studies to determine the relative importance of different locations as regards weevil shelter. These records are particularly important in connection with the Florida method of weevil control, since this method is largely based on accurate hibernation records.

The question of the effect of the use of poisons for boll-weevil control on adjacent bee colonies was investigated in the vicinity of Tallulah. It was found that no important mortality of bees resulted in any instance from the application of calcium arsenate to cotton plants. It therefore appears that there is no reason to believe that bee colonies would be seriously affected under the conditions existing at Tallulah. However, cotton does not appear to be an important honey plant at Tallulah, and it is possible that different results might be secured in other districts.

The annual dispersion of the weevil was determined in the fall of 1922 as usual. The summary showed that only 4.01 per cent of the cotton crop of the United States is produced in the territory not yet infested.

The usual outbreak of the cotton leafworm in 1922 presented several new problems of control, particularly in relation to the insecticides to be used. Some special studies were conducted on this point and are being continued.

Tobacco insects.—The experiments begun last season in the Burley district in Kentucky upon the control of the tobacco hornworm met with a most flattering reception. The Burley growers knew but little about modern methods of controlling the hornworm, and they are rapidly adopting the cheaper and more thorough methods advised by the bureau.

True wireworms cause an annual loss of from $1,000,000 to $2,000,000 to the Burley tobacco growers. In a series of five careful experiments the nitrobenzene-flavored bait reduced the infestation by as much as 50 to 60 per cent. This promising line of work will be enlarged next season.

A poisoned bait using nitrobenzene as an attractant was again tested on sod webworms and found effective.

The development of mule-drawn dusting machinery has been continued. The tandem-wheel, two-row duster mentioned in the last annual report is being made commercially. It supplies the need of the larger acreage very well, but on account of its cost a lighter and cheaper two-row machine has been devised for smaller acreages and will be tested during the present season.

An excellent piece of work has been accomplished at the Quincy, Fla., laboratory in fully working out the life-history stages and seasonal history of the tobacco flea-beetle and in completing a long existent gap in seasonal history of the tobacco budworm. Preliminary control work was instituted against the budworm in the sun-tobacco district at Tifton. Ga., and a method of control adapted to sun-tobacco conditions was partially worked out.

Sugar cane, rice, and cactus insects.—Work has been continued on the rearing and release of *Habrobracon brevicornis*, a parasite of the European corn borer which was found to attack the sugar-cane moth borer. The parasite has not yet been recovered in the field.

The tachinid parasite *Lixophaga* (*Euzenilliopsis*) *diatraeae*, introduced from Cuba in 1919 and 1920, was found in the fall of 1922 to be present on 14 plantations out of 41 where releases had been made. Since the parasites were released they have been found at 25 plantations altogether, but hardly a trace of them can be found in a field after one or two hours' careful search. It seems that the parasites are merely able to survive without multiplying to any extent or that they are attacking the moth borer over a wide radius from the place of release. Hundreds of borers are collected every summer for other experiments, but a parasite is never found among them. It is worthy of note that one parasite of this species was found at Pass Christian, Miss., though none was released nearer that place than New Orleans, nearly 60 miles away.

Experiments were conducted in soaking sugar-cane stalks in hot water to kill borers before planting. Dr. E. W. Brandes, of the Bureau of Plant Industry, suggested such work as a method of securing uninfested seed cane for an experiment station of the Bureau of Plant Industry, and it was also his idea that the growth of the cane would be hastened. An immersion for 20 minutes in water at 50° C. was found to kill all borers and also to hasten the germination. The treatment was satisfactory on cane planted in the fall, but many eyes were killed on cane planted in the spring.

Chemicals applied to planted cane to destroy borers in the stalks have not so far been found satisfactory.

Life-history studies are being conducted in cooperation with the Mississippi State Plant Board on the new pink borer of sugar cane found near Gulfport. More recently one specimen of this insect, the adult of which is unknown, was found in corn near New Orleans, but in the direction toward Gulfport. While the insect is capable of considerable injury, its life cycle seems to be so prolonged that it seems unlikely to become of any great importance. There is probably only one generation during the year.

Work was done during the fall and winter at Cairo, Ga., in mapping out the distribution of the sugar-cane mealybug, which was not previously reported from that section. It was at first thought that eradication might be possible, but the mealybug was found generally distributed over the sirup-producing section around Cairo. Experiments in controlling the ants in the fields, and thus controlling the mealybugs which they protect, were started.

The various pests of the rice plant and their control are being studied.

A trip was made during the winter to the west coast of Mexico and Lower California in company with two employees of the Federal Horticultural Board. Information was secured on the distribution of sugar-cane insects, and a borer, *Diatraea canella*, was found which had not previously been reported from Mexico. A tachinid parasite, *Phorostoma* sp., was found in tunnels of sugar-cane borers at Tepic.

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## INSECTS AFFECTING THE HEALTH OF MAN AND DOMESTIC ANIMALS.

The screwworm and blowflies.—Investigations under this project have been continued at the field stations of the bureau located at Dallas, Uvalde, and Sonora, Tex. Certain phases of this work have been carried on in cooperation with the Bureau of Chemistry and the Texas Agricultural Experiment Station as heretofore.

Tests of the efficacy of several different types of traps, bait pans, and baits under range conditions have been continued. The conical screen trap advocated by the bureau is now being rather generally used in the worst screwworm districts of the Southwest with very satisfactory results. Experiments carried out during the fiscal year indicate that where wild animals, such as rabbits and prairie dogs, may be obtained readily for bait they may be more economically used than commercial dried baits, especially if they are kept moist and maggot breeding is prevented by surrounding the bait in the pan with water containing borax or nicotine sulphate. By the use of these larvicides, the attractiveness of the bait is prolonged, since it is not so promptly destroyed by the maggots. Further experiments with commercial dried egg have been carried out. It has been found that this forms a very satisfactory and reasonably priced bait when each bait pan is charged with 6 ounces of dried egg to which have been added 5 grams of sodium carbonate and 1½ quarts of water.

Experiments with larvicides for use in destroying screwworms and other maggots in wounds on livestock have been continued. As a result of this work it has been found that benzol (100 per cent) is very promising. It is not only reasonable in price, but destroys the larvæ well, does not have a deleterious effect on the wound, and has good keeping qualities.

Extensive tests have been carried on with various chemicals with a view to securing suitable repellents for use in keeping flies from infesting wounds. Experiments with meat placed in jars under close observation have been continued on an extensive scale, and many of the most promising repellents have been tested on livestock under range conditions. Among the most promising mixtures thus far discovered are furfural 1 part, commercial pine-tar oil 3 parts, and safrol 1 part, medium pine tar, 3 parts. Several of the lighter pine-tar oils have shown marked repellent effect. It is planned to test on wounds the whole pine-tar series in combination with other repellents.

The ox warble or grub of cattle.—This project has been continued along the lines indicated in previous reports. Further information of considerable economic value has been obtained on the biology and seasonal history of the two species of warbles in different parts of the country. A few preliminary experiments have been inaugurated to determine the damage caused by this insect, especially on dairy cattle.

Some educational work incidental to the investigations has been done with a view to showing the livestock raisers the importance of the control or eradication of this pest. As a result of this year's work no information has been gained which indicates that eradication on a county basis as planned will not prove successful if properly financed.

A number of tests have been made with the destruction of the warbles in the backs of cattle by applying powders and washes. As a result of this work it has been found that over 98 per cent of the grubs can be killed with a general application to the backs of cattle of powdered derris root. A wash consisting of 1 pound of derris, 4 ounces of soap, and 1 gallon of water has also given a percentage of kill above 96. An ointment consisting of 1 part derris and 5 parts vaseline has also given almost 100 per cent kill when the material was pressed into each hole. Injections of 100 per cent benzol with an oil can have also given almost complete destruction of all warbles treated.

LICE AFFECTING LIVESTOCK.—Investigations of the life history, habits, and longevity of the biting and sucking lice of the goat have been carried forward in cooperation with the Texas Agricultural Experiment Substation No. 14 at Sonora, Tex. Much difficulty has been experienced in attempting to rear these insects under control, thus making progress slow. Some experiments with the dipping of goats in arsenical solutions of different strength have also been carried out.

Further tests of insecticides in dry form have been made against cattle lice. In this work the discovery that hellebore when dusted over lousy animals will give complete destruction of both biting and sucking lice is worthy of note.

POULTRY PARASITES.—Further studies on the biology and control of the stick-tight flea have been carried out at the Uvalde station, and a brief report of the work has been published in the Journal of Agricultural Research. Additional experiments on the control of the common poultry mite and the fowl tick or "blue bug" have been carried out. In this connection some attention has been given to the possibility of destroying these and other external parasites of poultry by administering certain chemicals and chemical compounds in the food and water.

MALARIA MOSQUITOES.—The clinical and biological investigations of certain experimental control measures, conducted by the International Health Board and the bureau, were brought to a close at the end of 1922 upon the completion of the original three-year program. The accumulated notes and records were then taken to Baltimore, where, with the assistance of the department of biometry and vital statistics of the Johns Hopkins School of Hygiene and Public Health, the data were summarized and studied and reports prepared for office records and publication.

The full report covering this work was divided into the following sections, the titles of which indicate the field covered by the joint investigation:

The experimental control units and comparative malaria incidence.
A statistical study of the occurrence of malaria in the population as a whole.
Collections and comparative abundance of Anopheles in different units and localities.
Studies of Anopheles infection under natural conditions.
The identification of the blood meal of mosquitoes.
The blood-feeding habits of malaria-carrying mosquitoes.
Preferential feeding experiments with Anopheles.

Of the above, the last three manuscripts dealing with the blood-feeding habits and host preference of Anopheles were prepared for

immediate publication and were submitted to the American Journal of Hygiene.

The larval investigations which have been carried on by the bureau during the past three years, independently of the cooperative work, have also been summarized and a complete report prepared. From this, one article has been prepared in condensed form for publication, giving an account of the natural breeding places of Anopheles in the locality of Mound, La.

At the beginning of the present season, work was started on the following three projects and is now being conducted along these lines:

Methods of larval control adapted to local conditions.
Chemotropic responses and trapping of adult Anopheles.
Continuation of the host-preference experiments. (In cooperation with the department of immunology of the Johns Hopkins School of Hygiene and Public Health.)

## INSECTS AFFECTING FOREST RESOURCES AND SHADE TREES.

Dr. A. D. Hopkins has continued as leader of this branch of the bureau work.

### INSECTS DAMAGING FOREST TREES.

Studies of the principal forest insects of the United States, and especially of the destructive pine bark-beetles, carried on for many years, have resulted in the gaining of knowledge which is now being put into effect in the most practical way in large-scale forest-insect control carried on in cooperation with private owners and other branches of the Government service. Some of the principal projects are mentioned below.

The southern Oregon-northern California control project.—In my last annual report I stated that this control project is the largest single one of the kind ever attempted. It is now in its second season, and it is expected that the bulk of the work will be completed by the close of the season of 1924. The cooperation has been admirable. The Forest Service of this department, the Indian Service of the Interior Department, and the private owners, represented by the Klamath Forest Protective Association, have worked in the greatest harmony, and the operations have been planned and supervised by the Bureau of Entomology. The area over which this epidemic of pine bark-beetles extends is a little larger than the State of Delaware, and in the last 10 years in this region the western pine beetle has killed over a billion board feet of merchantable yellow pine timber valued at over $3,600,000. It may incidentally be mentioned that this is fifty times as much as has been killed by fire on the same area during the same period. It has already been shown that with the establishment of as effective beetle control as has been established for forest-fire control, losses due to the beetle can be reduced to a minimum. Since the project was started last year, 260,343 acres have been gone over at a total expense of about 36 cents per acre. It will take another year to finish this work, and then, with some expenditure for maintenance, it is very probable that nearly complete control of the possible insect damage can be maintained. The private owners, the officials of the Forest Service, and those of the Indian Service are greatly pleased

by the results of this work and enthusiastically advocate its continuance.

The Antelope control project.—This project is located in northern California, and has been carried on in cooperation with a lumber company. The cost of this work has been paid by the owners, and it was done under the supervision of an expert of the bureau located at the Ashland (Oreg.) station. The work has been practically completed except for subsequent maintenance work. An area of 52,000 acres was brought under control, and the annual loss on the area has been reduced to from 1.4 to 0.4 per cent. The annual saving indicated shows a considerable profit over the cost of the operations.

Grand Canyon–Kaibab control project, Arizona.—This project, mentioned in my last report as having been entered upon cooperatively by the Forest Service, the Park Service, and this bureau, was undertaken on account of the beetle infestation over an area including about 80,000 acres in the Grand Canyon National Park and the Kaibab National Forest. More than 20,000 acres have been covered in the work so far.

Other control projects.—A test of maintenance control is now in its fourth season, in cooperation with the Forest Service, under the title "The San Joaquin project." A small investigational project along maintenance lines has been begun in the Helena National Forest, in Montana, and another one of the same character has been carried on in the Santa Barbara National Forest under the title of "The Figueroa project." Examinations which have been made over an area on the Modoc National Forest, in California, indicated infestation by bark-beetles, and control work has been begun by the Forest Service under the supervision of experts of this bureau. Other field studies have been made over areas of windblown timber and of slash, and certain conclusions of practical value have been reached.

The southern pine beetle.—During the latter part of 1922 and early in 1923 it became obvious that a serious outbreak of the southern pine beetle was threatening in southern Virginia. In this region this insect had not occurred in dangerous numbers for many years. Demonstration control work in Accomac and Northampton Counties, Va., and at Ashland, Va. (near Richmond), have resulted in effective control, and a threatening epidemic has apparently been checked. There is some evidence that this southern pine beetle is locally destructive in other more southern States, and examinations are to be made in these regions in the near future.

The spruce budworm.—The spruce budworm has been studied in New England and in the Lake States, and has made its appearance in injurious numbers in northern Idaho. What appears to be this species is also causing the defoliation of the Douglas fir and the Engelmann spruce in the Yellowstone National Park in Wyoming. It is being studied by one of the department's experts stationed at Coeur D'Alene, Idaho.

Other forest insects.—Additional studies have been made of the Pandora moth, which has been defoliating pines near the Klamath Indian Reservation in Oregon, of the large sawfly which threatens an outbreak in the upper peninsula of Michigan, of the Nantucket pine moth, which is doing some destructive work at Halsey, Nebr.,

and of pine needle miners, which are apparently increasing in parts of Oregon.

### INSECTS AFFECTING FOREST PRODUCTS.

Studies have been made and practical experiments carried on in connection with insect damage to crude forest products as well as finished forest products. Variations in management and experiments in sun curing, water submerging, seasonal cutting, and chemical sprays have been carried on with very satisfactory results in nearly all cases. Studies of chemical root preservatives, of woods resistant to the attack of white ants, and of the effect of different temperatures in kiln drying for killing the powder-post beetles have also given interesting results. Much technical research work with the insects concerned has been done.

### INSECTS AFFECTING SHADE TREES AND HARDY SHRUBS.

The demand for information concerning insects of this class is rapidly increasing. Many hundreds of letters of inquiry are received from all parts of the country. Special studies are being made of a number of species of insects that attack trees of this class, special work being done in the East (at Washington) and in the far West (at Palo Alto, Calif.), and the bureau is now in a position to give advice in this direction which will be of great use to the parking authorities of cities and towns.

## BEE-CULTURE INVESTIGATIONS.

The work of the bee-culture laboratory, under the supervision of Dr. E. F. Phillips, has been continued along the same general lines as formerly. The laboratory and the apiary of the bureau are located at Somerset, Md., near Washington.

Behavior of bees.—The work on the responses of bees to changes in the temperature and humidity conditions of the bee colony was continued through the entire active season of 1922 and the same work was carried on during the month of May, 1923, in order to increase the data for the period of the heaviest honey flow. It is found that there is a definite and very close control of the temperature of that part of the hive in which brood is reared, but that in the parts of the hive in which nectar is being stored and ripened into honey the bees exercise little if any temperature control. This at once suggests the desirability of insulation for the part of the hive devoted to honey storage, but further experiments will be necessary to determine whether this would add materially to the honey crop. Extensive records have now been collected and work has been begun in their analysis and in preparation of some of the data for publication. It is found that each honey flow exhibits characteristic changes in the weights hour by hour, doubtless because of variations in the time of day when nectar secretion occurs in the different species of plants.

The investigation of the amount of brood within certain colonies at weekly intervals throughout the brood-rearing season, conducted by W. J. Nolan, is being continued with a few colonies during the present season. During the summer of 1920 records were made on

five colonies by direct counting of the brood. In order to interfere less with the colony activity, records were made during 1921 by means of photographs of the sealed brood in 16 colonies, and in 1922 this was done with 32 colonies. The work during 1923 is on 8 colonies only, to clear up certain points not fully explained by the previous data. A manuscript has been submitted for publication giving a summary of the results of the work for the first two years, and two papers have been prepared for publication outside the department in which certain points in this investigation are discussed.

During the latter part of the season of 1922, observations were made on the feeding and care of honeybee larvæ during the various periods of their larval development. It is found that the food given the larva just after hatching is given at one time, in what has been designated mass feeding. After the original food supply is exhausted, which occurs at about the end of the second day of larval life, feeding continues as needed by the larva by what has been designated progressive feeding. The change from mass feeding to progressive feeding is doubtless correlated with the change in the composition of the larval food which has long been known to occur, but which was formerly believed to occur much later. A manuscript on this subject has been submitted for publication by the department. The work on the responses of bees to light of various colors and intensities was continued through the active season of 1922 and has been renewed during the present season.

The manipulation of wax and wax scales by the bees has also been studied, carrying this work on from the points studied by Casteel several years ago in this laboratory, and the manner in which the wax is handled by the mandibles of the bee when being elaborated into the comb has been determined.

The work on the flight of bees by the special apparatus devised by A. E. Lundie has been completed and the results incorporated in a manuscript which has been submitted for publication by the department. A large variation has been found in the flight of bees according to temperature conditions and also with regard to the honey flows.

Physiology of bees.—The work mentioned in the last report on the availability of various carbohydrates to bees has been continued, certain additional observations having been advisable because of the publication of a paper by certain foreign observers on the enzymes found in the alimentary tract of the bee, the results of which failed to agree fully with the findings in the present investigation. A repetition of the work with certain modifications has failed to change in any way the results reported last year, from which it is concluded that the determination of the enzymes in the alimentary tract alone is not a reliable guide in determining what foods are available to honeybees. A brief summary of the results of this work has been prepared for publication outside the department.

The work on the changes in the œnocytes according to the age of the worker bee has been continued during the present active season. While certain changes are observed in these peculiar cells during the course of the life of the worker bee, the significance of these changes is not yet wholly clear.

The rate of growth of the honeybee larvæ has long been recognized as exceedingly rapid. During the past year a paper by Drs. James

A. Nelson and A. P. Sturtevant was submitted for publication, in which the results of careful weighings were recorded at intervals during the entire period of larval development and during the first part of the period when the developing larva is sealed over. It is found that the larva increases in weight 1,550 times during a period of five and a half days and that during the early part of the larval period the rate of development may reach 621 per cent a day.

It appears that the number of molts of the developing larva has never been accurately determined. A study of this subject has been undertaken and it has been found that, in spite of the excessive rate of development and the constant increase in size during the feeding period, there are but four molts during larval life, and that considerable increase in body size and weight occurs between molts.

In connection with observations on the behavior and physiology of the bee, constant need is felt for more detailed information on the anatomy of the adult bee.

The study of the colors of American honeys, begun in cooperation with the Bureau of Agricultural Economics, has been continued during the present active season. The various samples of honey, 450 in all from all parts of the country, have all been measured for the transmission of lights of various wave lengths by means of the spectrophotometer, and the samples have been arranged according to this transmission of light. There are no natural divisions of honey into colors, so that whatever grades are established must be more or less arbitrary. An effort is now being made to obtain materials which will give proper color values for honey graders.

The examination of the pollen grains in the honey samples collected, which is being done in the microchemical laboratory of the Bureau of Chemistry, has shown that in all probability this is not a safe way to determine the floral source of honeys, as has been commonly assumed.

In connection with the study of the colors of honey, it was found that honeys vary greatly in their transparency even though there is no granulation. To determine the cause of the cloudiness, arrangements were made during the past fiscal year for a cooperative investigation of the materials in honeys other than the three common sugars, and an expert was appointed for this work, which is being done in the carbohydrate laboratory of the Bureau of Chemistry. Five separate plant-coloring materials have so far been extracted from normal honeys. Some of the coloring materials are colloidal, which doubtless accounts in part for the cloudy effects observed in some samples.

Diseases of bees.—Work on the distribution of the Isle of Wight disease of bees has been continued through a careful survey of all records available from foreign countries, and a manuscript has been submitted for publication in which are recorded for the use of American beekeepers all available data on this subject, together with a statement regarding the steps taken by other countries to control this disease or to prevent its introduction where it is not yet found. The disease is now definitely found throughout the British Isles, in France, and in French Switzerland. Importation of bees has been restricted in Switzerland, the Union of South Africa, Australia, and the Dominion of Canada, as well as in certain other countries,

in order to prevent the further spread of this serious disease of adult bees.

Work has been continued on the examination of diseased or abnormal adult bees from all parts of the United States. During the active season of 1922 samples to the number of 184 were examined, but just as in this work for 1921, no samples were obtained in which the mite causing the Isle of Wight disease was found. During the season of 1923 this work is being continued, and so far the results are still negative for bees from the United States. The records of the examinations for 1922 are incorporated in the above-mentioned manuscript on the distribution of the Isle of Wight disease.

On the basis of the negative findings in the search for the Isle of Wight disease in the United States, as stated in the last report, a bill was introduced into Congress to prohibit the importation of adult bees, except from countries in which it is determined that no diseases dangerous to adult bees exist or for experimental or scientific purposes by this department. This bill was passed by Congress in August, 1922, and was approved by the President on August 31, 1922.

In accordance with the provisions of this act, regulations have been approved by the Secretary of the Treasury and the Secretary of Agriculture which permit the importation of adult bees without restriction from the Dominion of Canada and which further define the methods by which adult honeybees may be imported for experimental and scientific purposes. Additional special rules on this subject were more recently approved by the Secretary of Agriculture. Provision is made for importations necessary to prevent any deterioration of the stock of the bees in this country and for providing all scientific workers with necessary imported breeding stock. Since the regulations and special rules were not adopted until near the close of the fiscal year, no importations could be made until after the close of the year, but arrangements were made for the importation of some breeding stock under the provisions of the regulations.

A manuscript has been prepared dealing with the morphological structures involved in the Isle of Wight disease, with a discussion of the respiratory system of the normal bee. This clears up many questions regarding this disease, which is concerned solely with the respiratory system.

The investigations on the etiology of the brood diseases of bees have been continued. A paper has been submitted for publication in which the results of the biochemical study of the larva before and at the time of death by American foulbrood are discussed. It is found that the development of the causative organism and the consequent death of the larva do not occur until the sugar content of the larval intestine is quite low, and that this is the cause of the marked regularity in the time of death and in the resulting uniform positions of the dead larvæ which are characteristic of this disease, and in marked contrast to conditions found in the other disease of the brood of bees, European foulbrood. The results of this investigation of the chemistry of the larvæ were correlated with the biochemical and cultural characteristics of the causative organism. In order that this investigation might be carried out, it was necessary to devise somewhat new methods of analysis, and thus for the first time it was established that there is a considerable unassimilated sugar content in the developing larva. This work was cor-

related with the glycogen, fat, and nitrogen content of the larvæ and pupæ, both in health and in disease.

During the past fiscal year samples were again examined for beekeepers and apiary inspectors, and this is one of the most valuable routine services rendered by the laboratory. During the year 1,029 samples of brood and adult bees were examined.

Beekeeping regions of the United States.—Lack of funds has prevented much work on this subject during the past year, although there is great need for additional investigations. A considerable amount of information on this subject constantly comes to the laboratory from all sources and this is carefully catalogued for future use, when more serious investigations become possible.

Demonstrations in beekeeping.—The work on this project has been still further decreased during the past year. During and immediately following the war there was such a demand for this work that the time and funds of this office were largely directed toward the education of practical beekeepers. Gradually this work has been turned over to the several States and at present the bureau is cooperating in this work in only three States. Arrangements are being made still further to curtail this support in the near future. No marked change in the policies of this work has taken place during the past year, emphasis still being given to the proper training of those who desire to make beekeeping a major part of their work.

The extension work begun by this office in various States has been continued by the several States almost without exception, indicating that it fills a real need in the promotion and development of beekeeping in this country. With the present condition of the honey market and the low prices obtained by beekeepers for their products, beekeeping is in great need of proper encouragement in order to continue the industry in the place which it attained during and immediately after the war. No extension short courses for commercial beekeepers were held during the past year.

Miscellaneous activities.—The correspondence of the office continues to be heavy. While the beekeepers of the country are considerably discouraged at present because of low honey prices in the general market, they are as a rule still caring for their bees as well as formerly and are continuing to send inquiries to this office as much as formerly. Part of the heavy correspondence of the office arises from the examination of samples of bees and diseased brood of bees and from the examination of honeys for color.

Mention should be made of the cordial cooperation received by this office from other divisions of the department the work of which concerns the beekeeper. The carbohydrate and microchemical laboratories of the Bureau of Chemistry are both rendering valuable aid. Three offices of the Bureau of Agricultural Economics are doing work of great benefit to beekeepers and the cooperation with the extension offices of the department continues to be cordial in the management of the decreasing amount of extension work which this office is doing. From time to time various other offices and bureaus must be called upon in the work of this division, and in all cases the response is all that may be asked. Because of the widely diversified nature of the work of this division, such cooperative efforts are made vitally necessary, and it is extremely fortunate that the beekeepers of the country may have the facilities of all these divisions of the department at their disposal.

## INSECT PEST SURVEY.

J. A. Hyslop has continued in charge of this branch of the bureau's work since its inception in March, 1921. The survey has now functioned two years and three months. It has filled the need that has long been felt among entomological workers for a medium through which they could be kept closely in touch with insect conditions in the various parts of the country, and for a permanent record of these conditions correlated with the prevailing meteorological conditions from year to year, which should, in time, serve as a fundamental basis for the next departure in economic entomology; i. e., entomological forecasting. This work has been so successful that a similar survey has been inaugurated within the year in the Dominion of Canada, along lines very similar to those of the bureau's organization.

During the fiscal year 1923 the survey completed volume 2 of its monthly bulletin, comprising Nos. 5 to 8, inclusive, 130 pages of text material and an index of 34 pages, and the first 4 numbers of volume 3, comprising 162 pages of text material. The magnitude of this work is indicated in that 507 different species of insects were recorded in volume 2 of the Insect Pest Survey Bulletin as of more or less economic importance in some part of the United States.

As an incident to the work of the survey a card index has been prepared of the common names applied to insects in this country. This card index now includes about 4,500 common names. The index is arranged alphabetically, first, under the common names and, second, under the Latin names, which facilitates the finding of the common name of any insect. This card index is now also being used by the bureau committee which is cooperating with the American Association of Economic Entomologists in standardizing common names, and forms a basis for the work of this committee.

During the past year the entomologist in charge of the survey held one meeting of the survey's collaborators at the time of the annual meeting of the American Association of Economic Entomologists. At this meeting considerable progress was made in organizing the survey and standardizing survey methods. In addition, a cooperative agreement was effected with the entomologist of the Dominion of Canada for an exchange of notes, whereby each survey now publishes the outstanding entomological features of the neighboring country.

During the past season the annual summary for 1921 was issued, comprising a report on 19 of the more important insects of the year. It has been found very desirable to increase materially the scope of the annual summary, and the summary for 1922 will cover 39 species of insect pests. Owing to this increase in the scope of the work and the increasing mass of material being received by the survey from its collaborators for monthly publication, the completion of this summary is very much delayed.

# REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
*Washington, D. C., September 12, 1923.*

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1923.

Respectfully,

E. W. NELSON,
*Chief of Bureau.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## ORGANIZATION OF THE BUREAU.

In order to conduct the necessary investigations relating to our wild birds and mammals and to promote the conservation of the useful and harmless species and to destroy those that are harmful, the Biological Survey is organized under the following divisions:

1. Economic Investigations, Dr. A. K. Fisher in charge. Develops methods of control and cooperates in campaigns for the destruction of predatory animals and injurious rodents. Has supervision also of an experimental fur farm and cooperates in fostering the fur-farming industry and in the conservation of fur-bearing animals.

2. Food Habits Research, W. L. McAtee in charge. Investigates the food habits and economic relations of birds, reptiles, and amphibians. Makes studies of the food resources of water areas for migratory wild fowl, to improve production, and devises practical methods of control for injurious birds.

3. Biological Investigations, E. A. Goldman in charge. Investigates the distribution, migration, and other habits of wild birds and mammals and the distribution of wild plant and animal life in relation to climate for the purpose of mapping the life zones of North America. Makes technical laboratory and field studies of birds and mammals. The scientific results of the work of this division form the basis for the increasing economic activities of the bureau.

4. Alaska Reindeer and Fur Bearers, E. W. Nelson and W. F. Bancroft in charge. Investigates diseases and parasites of reindeer and studies forage plants, grazing areas, herd management, and other problems relating to the upbuilding of the reindeer industry. Administers the law protecting Alaskan land fur animals and makes investigations to assist in developing fur farming in the Territory.

5. Game and Bird Refuges, Smith Riley in charge. Supervises the maintenance of Federal big-game and bird refuges and the warden service on them, and the production of hay and feeding of elk on the winter Elk Refuge.

6. Migratory-bird Treaty and Lacey Acts, G. A. Lawyer in charge. Administers the laws for the protection of migratory game and other birds, for the prevention of illegal interstate shipments of game, and for the prevention of the importation of harmful species of wild birds and animals.

## ECONOMIC INVESTIGATIONS.

### WILD ANIMAL PESTS.

The national forests and other great areas of public lands in the Western States are the main breeding places of wolves, coyotes, mountain lions, and other stock-killing animals, and of prairie dogs, ground squirrels, pocket gophers, and many other forage and crop destroying rodents. For the purpose of reducing losses in livestock and forage on the public domain and to cooperate with the States, local organizations, and individuals in campaigns for the destruction of these wild animal pests on State and private lands an appropriation of $440,121 was made available by Congress for the year, of which $276,890 was used for the destruction of predatory animals and $163,231 for work in rodent control. Twelve of the public-land States made direct appropriations of cooperative funds to use with the bureau for this fiscal year. Furthermore, seven additional States provided cooperative funds without direct appropriations, which made a total of $844,000. Of this, approximately $243,000 was for the destruction of predatory animals and more than $601,000 for the rodent campaigns. From the beginning of this work the survey has maintained that eventually it would be practicable completely to destroy some of the worst of these animal pests and thus forever eliminate the heavy losses they have been causing. Through the campaigns against them prairie dogs have been exterminated on considerable areas, and the large wolves, of which 4,900 have been killed, are being so reduced in numbers that over most if not all of the West their end is in sight.

The best evidence of the growing appreciation of the practical value of campaigns against animal pests in the West was given in the winter of 1923 by the legislatures of 13 States, which made total appropriations of about $647,000 for cooperation in the work during the following biennium.

The results obtained in the campaigns against animal pests have been possible only through the hearty cooperation of States, local organizations, and individuals. In addition to funds contributed more than 104,000 farmers and stockmen took an active personal part in the rodent field work. Good progress was made at the Denver laboratory in working out poison combinations to increase the effectiveness of the field operations. Application has been made for a patent in favor of the Department of Agriculture to cover a new poison combination that in field tests has given remarkable results with both predatory animals and rodents.

### PREDATORY ANIMALS.

Organized field operations against predatory animals were in progress during the year in Arizona, Arkansas, California, Colorado, Idaho, Michigan, Montana, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. Requests for assistance have also been received from Louisiana, Wisconsin, Minnesota, North Dakota, and Indiana. As a result of demonstrations given in Missouri the State legislature appropriated $15,000 for cooperation with the bureau in the destruction of predatory animals through the State Board of Agriculture and also provided that in further cooperation the State game department might expend funds at its disposal. South Dakota for the first time provided a cooperative fund of $30,000 for use during the ensuing biennium.

In connection with its work on the national forests and other Federal lands, the bureau has enlisted the cooperation of other Federal, State, and private agencies in order to correlate all efforts in an effective drive for the destruction of predatory animals on Federal, State, and private lands, thus giving general protection to livestock. State agencies taking part have included departments of agriculture, livestock commissions or boards, game commissions, extension departments of the States, county organizations, stockmen's associations, and individuals. Cooperation with other Federal agencies which control areas of Federal lands included the Forest Service of the Department of Agriculture, the Office of Indian Affairs, and the National Park Service of the Department of the Interior. The Bureau of Plant Industry and the Bureau of Chemistry, of the Department of Agriculture, have rendered important assistance in connection with laboratory investigations.

Improved poison combinations and their systematic distribution have been so successful that poisoning is rapidly superseding other methods of predatory-animal control. The great increase in territory that can be covered by poisoning campaigns, as now conducted, for the first time offers a possibility of eliminating coyotes over vast areas. This has hitherto appeared doubtful, owing to the numbers and wide distribution of these pests. More than 200,000 square miles were covered by organized poisoning operations during the year, and at carefully established poison stations on this area more than 1,703,000 specially prepared poison baits were distributed.

Present methods in poisoning operations are the result of gradual development and are based on both laboratory and field investigations. From the beginning it has been recognized that the development of an effective poisoning procedure would be essential to the ultimate handling of the coyote problem. The results now being obtained surpass even the expectations at the beginning of the experiments.

Inspectors and field assistants have given special attention to cooperative work with stockmen's associations, which employ men to establish poison stations and distribute the baits in accordance with demonstrations and directions given them. Stockmen and their ranch foremen have also been trained in modern poisoning and trapping methods and have participated more extensively than ever before in the actual work.

During the year an average force of 250 hunters, trappers, and poisoners was employed under bureau supervision, in addition to the thousands of stockmen who personally took part in the work. Part of the men employed were paid from Federal funds and part by the States and other cooperating agencies. During the year hunters took the skins or scalps of more than 29,300 predatory animals, of which 599 were wolves, 447 of these being the large gray wolves; 25,622 coyotes; 2,822 bobcats and Canada lynxes; 158 mountain lions; and 101 bears. Bears are regarded as game animals and no effort is made to take them, except individuals known to be destructive to livestock.

In view of the substitution of poisoning campaigns for other methods of field operations in most of the districts during six to nine months of the year, the number of skins and scalps taken is no longer a satisfactory gauge of the number of animals killed. Men spend practically their entire time in establishing poison stations and distributing baits, and relatively little time in searching for animals killed, as the value of the skin commonly does not pay for the time lost. One man in the Lemhi National Forest, Idaho, by use of an automobile maintained a poison line 700 miles in extent, which served to cover an area of about 5,000 square miles. This method of procedure has been strongly urged by stockmen, who, convinced of the effectiveness of the poisoning operations, are more concerned to have the poison distributed carefully on a large scale than to have hunters spend time searching for animals killed. The carcasses are usually found later by the stockmen.

From 5 to 15 dead coyotes are commonly found near a single poison station, and one stockman reported having seen 22. In one day one of the demonstrators put out a poison line 35 miles long, and, returning along it the following morning, saw from his automobile 14 dead coyotes. Another hunter, who put out 400 baits in the vicinity of several reservoirs, later found 57 dead coyotes, and a stockman reported finding 60 more coyotes that had been killed but had not been found and scalped by the hunter. The manager of a large ranch in Texas, on which about 12,400 baits were used, reported that at least 1,000 coyotes were killed. Previous to poisoning, a trapper on this range was able to take from 60 to 70 coyotes per month, but after poisoning the best a skilled trapper could do was to take 10 to 12 per month.

Complete returns of predatory animals killed in the United States in poisoning campaigns can not be obtained, but the sudden marked reduction in the numbers of coyotes over great areas and the number of carcasses subsequently found by stockmen on their ranges and by hunters about poison stations where it has been possible to make careful observation, indicate the strong probability that not less than 75,000 coyotes were killed by the poisoning operations; the carcasses of these were not found, however, in time to be recorded. Many wolves, bobcats, and a few mountain lions also were poisoned. On the generally accepted basis of calculation the killing of these predatory animals with those of which the skins and scalps were secured represents an annual saving in livestock and game of more than $5,979,000. Skins sold during this year yielded $34,839 to the Federal Government and $39,668 to cooperating States and stockmen's associations.

Poisoning operations are conducted chiefly from October to April, but effective work was done even in summer, especially about watering places in the drier areas used for winter grazing. When practicable the major poisoning operations are carried on at times when livestock is not present, poisoning on high summer ranges being done just after the stock goes to lower levels in fall. Poison stations are placed systematically over the range, especially in occupied territory. The advantage of systematic placing is that, in addition to the effectiveness of killing, warning notices can be posted so that valuable dogs or other animals may be protected. In addition, poisoned baits not taken by predatory animals can be picked up and destroyed or used elsewhere.

Such systematic work on summer and winter ranges and on lambing grounds has practically ended livestock losses over large areas. The destruction of predatory animals has been sufficient to enable many stockmen to reduce the number of men required to care for their flocks and herds. Some stockmen now report carrying their flocks through the lambing period with no loss whatever from coyotes, where previously losses were heavy. An important feature of this service is that it not only permits the stockmen to handle their herds at less expense but it also enables them to utilize the pasturage much more fully; to manage their stock to better advantage by eliminating long drives to bedding grounds; and to adopt the advantageous open-herding system. The destruction of predatory animals has also in some places permitted sheep raising to be introduced where formerly it was excluded on account of the losses inflicted by predatory animals.

Clearing the ranges of coyotes is proving a boon to the cattlemen as well as to the sheepmen, for with the practical elimination of the gray or timber wolf over much of the range country of the Western States, cattlemen have discovered that heavy losses of calves heretofore attributed to wolves have evidently been due to coyotes.

In the campaign which has been waged for the destruction of timber wolves, most gratifying results have been obtained. An effective patrol maintained along the border of Mexico has resulted in the killing of many animals which were crossing from Mexican territory into the ranges of Texas, New Mexico, and Arizona. Persistent work with poison and traps has so reduced the number of adult timber wolves that it probably does not exceed 10 to 50 adult animals in any of the various Western States. The ranges of practically all the wolves which have proved destructive to livestock are well known, and good headway has been made in clearing out these remnants. In many sections these animals have become so scarce that they are luring domestic dogs away as mates, and in a few instances are known to have produced litters of hybrid young.

A number of notoriously destructive individuals and even small packs of wolves have been destroyed during the past year. Among them the following may be cited:

In response to a telegram from stockmen ranging cattle near Thatcher, Colo., a hunter was detailed to take a wolf believed to be the leader of a pack depredating in the locality. Work against the wolves there had been in progress at intervals during the past five years, and inquiry established the fact that during the course

of six weeks 20 head of cattle were killed and the tails were bitten off a number of small calves. The hunter succeeded in trapping an old male wolf, with the result that depredations were entirely stopped in the vicinity, and evidence showed that only a lone she wolf still remained in that area. This female mated with a collie dog, and in efforts to get her, the collie was killed by poison and later she was taken in a trap. The stockman, on whose ranch the wolf was killed, writes as follows:

> Old Three-Toes, as this particular wolf was called, was caught in one of the Government traps especially constructed for wolves, and the hunter has caught two of her pups. With her capture ends the pack of which she was leader. Thousands of dollars worth of calves and sheep have been killed by this wolf and her pack. Just a few days prior to her capture, Old Three-Toes killed six calves here on our ranch, 11 miles west of Thatcher. We hold a private grudge against this old gray wolf, as she mated with our pet collie dog, even going so far as to dig him out of a pen. He heard the "call of the wild" and answered it, going off for days at a time, sometimes coming home for a few days. At last he went away for weeks and was finally poisoned by one of your men. This was a good thing, as a collie, hearing the "call of the wild," kills for his young, too. We extend our thanks for staying on the job and getting Old Three-Toes and her pack. Other stockmen join us in our praise of you and your men, as the loss from predatory animals has been reduced to almost nothing.

A stockman in Arkansas makes the following statement regarding work accomplished in his locality:

> Your hunter accomplished here what all others failed to do. These wolves have been hunted persistently for years, consequently had become very shrewd and cunning. I am one of the hunters of this locality myself, so realize what skill was required to capture such cunning animals. We have used every method we could think of against these wolves, but failed to do more than reduce them to some of the most cunning and destructive ones. We have used poison and traps and resorted to wolf drives, but still they stayed with us, taking an annual toll of thousands of dollars worth of calves, pigs, sheep, and goats. The second wolf your hunter captured was a notorious old male. I have known this wolf for the past five or six years and am quite positive that he participated in the killing of two large calves for me the past spring, as well as hundreds of pigs. It has been next to impossible for us to raise any hogs at all in this section. This particular wolf was an exceptionally large, cunning old fellow, having killed thousands of dollars worth of livestock for the stockmen of this county.

Another stockman reports that he missed a pig one morning and when the hunter ran his trap line that day he brought in a wolf with parts of the pig in her stomach.

### PREDATORY ANIMAL WORK IN MICHIGAN.

Depredations of wolves on deer in northern Michigan became so serious in 1921 that at the request of the conservation commission of that State one of the most experienced and competent wolf hunters of the bureau was detailed to Michigan for the purpose of training wardens to destroy these pests. Bounties on wolves, coyotes, weasels, woodchucks, crows, hawks, and owls, amounting to more than $312,000, were paid during the fiscal year ended June 30, 1921. All bounty payments have now been discontinued. The present plan of conducting systematic trapping and poisoning campaigns through warden-hunters, trained by our experienced man, as mentioned above, is costing the State $35,000 annually, the expense being borne by funds derived from hunting licenses. The work has been so effective that in some sections wolves have entirely disappeared and elsewhere are being rapidly reduced in numbers.

### NEW LURE FOR MOUNTAIN LIONS.

One of the important developments of the year has been the introduction of oil of catnip as a lure in trapping and poisoning mountain lions and bobcats. Heretofore the taking of mountain lions has been exceedingly arduous work because of the rough and inaccessible country which they frequent and the fact that it has been necessary chiefly to trail them with dogs and to shoot them when treed or driven into caves. A representative of the Biological Survey had ascertained that mountain lions and bobcats were attracted by the odor of catnip. Effort was made to obtain an extract of this plant or a synthetic product which would carry the attractive odor in a form sufficiently permanent for use in field operations. Oil of catnip was not produced on a commercial scale and the Bureau of Chemistry advised that only very minute quantities had ever been extracted in connection with laboratory experiments.

The securing of a supply of oil of catnip for the desired purpose is a most interesting case of effective cooperation. From the Drug Investigations Division of the Bureau of Plant Industry the Biological Survey in 1920 obtained a very small quantity, sufficient to determine that the oil carried the characteristic odor and that this would persist for several months when exposed in the open air. A small area was planted to catnip by the Bureau of Plant Industry on the Arlington Experimental Farm, from which enough was produced to extract sufficient catnip oil for a thorough test in field operations. It was found that the oil of catnip could be diluted with oil of petrolatum and still retain the characteristic odor. This permitted a more extensive use of the limited supply, and through it several mountain lions and large numbers of bobcats have been lured into traps or to take poisoned baits. The odor of catnip appears to exert an almost unfailing attraction for these animals and other members of the cat family. Discovery of this use of the material is an important contribution to the methods of taking these destructive animals.

### PREDATORY ANIMALS AND GAME.

State game departments and sportsmen's associations have cooperated heartily with the bureau in efforts to destroy predatory animals. Timber wolves, coyotes, wild cats, and foxes all join in game destruction, the kill being heaviest in winter when the snow is deep and especially in early spring after the snow becomes crusted. At this period wolves and coyotes often appear to kill for no apparent reason other than amusement or sheer lust of killing. During the spring and summer the losses of young game animals and the destruction of ground-nesting birds, their nests, and young is one of the most serious checks on game increase. In many sections of the West, where operations have been in progress for a sufficient length of time for the reduction of predatory animals to become effective, State game departments report a notable increase in quail, grouse, and deer.

RABIES.

Sporadic outbreaks of rabies have continued to occur in a number of the Western States, but have been kept under control by the prompt concentration of skilled hunters to destroy infected predatory animals and other carriers of the disease.

RODENT PESTS.

Investigations by the Biological Survey during a long period show conclusively that many species of rodents occupying the territory from the Great Plains west of the Mississippi River to the Pacific coast are exceedingly destructive to the most nutritious forage grasses and to crops. Through their excessive numbers they have thus become very serious competitors of livestock on hundreds of millions of acres as well as a heavy drain on the agricultural output. Losses from rodent pests in orchards, vineyards, and truck farms of the Eastern States are also reported to be severe by State officials and by employees of the bureau.

In 1916 it was estimated that the losses through rodents in the Western States amounted to about $300,000,000, of which $150,000,000 was in the destruction of forage and the remainder in the devastation of cultivated crops. This bureau, working in cooperation with State and local agencies, has conducted campaigns against these animals since that time and a large decrease in the losses has resulted.

These campaigns have been organized with a view to correlating all Federal, State, and local agencies into an effective cooperative force so that the work might be so systematically planned and conducted as, one after another, to clear great areas of rodent pests. This work has been backed by a remarkably sustained interest and strong financial support on the part of farmers and stockmen, who recognize the direct and definite benefits from it. The magnitude of the results of the campaigns has been achieved largely through the fine cooperation of the States Relations Service, now the Office of Cooperative Extension Work, with the State extension organizations, including the county agricultural agents, and State and county farm bureaus. State departments of agriculture are taking an increasingly large part in the undertaking through the establishment of pest districts and enforcement of State laws which provide for the clearing of rodent-infested lands on petition of the resident landowners. Many other agricultural, horticultural, and livestock organizations have also taken active part. Officials of the Forest Service, of the Office of Indian Affairs, and of the Reclamation Service continued to cooperate heartily in campaigns involving Federal lands under their control.

Where the strictly economic problems are involved with features relating to community health, as in bubonic and pneumonic plague, Rocky Mountain spotted fever, tularaemia, and kindred diseases disseminated by rodents, the bureau has continued to cooperate with the United States Public Health Service of the Treasury Department and with State, county, and municipal health organizations. Such cooperation is essential to an effective and economical handling of the work when such rodents as house rats and mice infest cities, villages, and the rural sections.

PRAIRIE DOGS AND GROUND SQUIRRELS.

Among rodent pests, one of the most conspicuous and destructive in the area which it inhabits is the prairie dog, but the various species of ground squirrels occupy a vastly larger area and because of their abundance and general distribution cause even heavier losses to farmers and stockmen. Prairie dogs occupy more than 120,000,000 acres of grazing and farming land in 11 States, as follows: Texas, New Mexico, Arizona, Utah, Colorado, Kansas, Nebraska, Wyoming, South Dakota, North Dakota, and Montana. Ground squirrels of the various species infest practically the entire country west of the Mississippi River. These animals cause enormous losses by digging up the planted seeds of farm crops and by cutting down the growing crops throughout the season to harvest time.

Over great areas both prairie dogs and ground squirrels reduce the forage available for livestock by as much as 25 per cent or more. Prairie dogs often completely denude productive lands of all grasses, leaving them to make barren wastes also of new locations where food is more readily available. In many places these bare areas grow up to worthless weeds and require several seasons before desirable forage plants are able to become reestablished. In other cases the top soil is washed away down to the bedrock or to a clay base, leaving more or less permanently waste land.

Not only do prairie dogs and ground squirrels select the more fertile lands, but their competition with livestock is rendered increasingly serious because they select and feed upon the same highly nutritious grasses which are most sought and fed upon by livestock. This not only results in a marked decrease in the numbers of livestock that can be carried on the grazing lands but it prevents complete success in efforts to increase the production of forage through improved range-management practices, such as deferred grazing or grazing rotation. The rodents prevent the normal growth and reestablishment of grasses during the interval that the stock are kept off such ranges, while the more abundant food supply thus made available to them is favorable to their more rapid multiplication, as it is found that their increase is closely correlated with the abundance of food.

In organized campaigns against prairie dogs and ground squirrels 13,673,079 acres of Federal and private lands were given a first treatment with poisoned baits during the year, and follow-up work was done on 12,358,315 acres. This makes a total of 11,093,884 acres of Federal and 97,718,640 acres of State and private lands on which the heavy percentage of these pests have been poisoned since 1916 in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. The bureau assumes the cost of operations on Federal land, although adjacent landowners often contribute the labor required for distribution of the poison and even the grain used as bait, in order that the limited Federal funds may be used to cover the largest possible acreage. State officials provide for work on State lands and farmers and stockmen on their own holdings. Funds contributed by State and county appropriations and those expended by landowners in this cooperative undertaking during the year amounted to $592,812.

Reduced cost of poison supplies made it possible materially to reduce the cost of treating lands. Poisoned grain amounting to 1,323 tons was prepared and distributed under the direction and supervision of bureau representatives and cooperating State and county officials, and 210,682 pounds of carbon bisulphide were used in fumigating burrows to eradicate these rodents completely. Farmers and stockmen numbering more than 104,000 took active part in clearing their lands. Taking into consideration the low prices prevailing on farm crops and range grasses during the year, it is estimated that a saving of more than $8,000,000 was thus effected. The estimated saving in crops and forage since this work was started on a large scale in 1916 totals $68,000,000. As lands are progressively and permanently cleared of these pests the savings effected become permanent additions to their productiveness.

Field operations against these rodents progressed during the year to a point where it appeared practicable to lay plans for three-year campaigns to exterminate the rodents in a systematic manner from great units of land. From 75 to 95 per cent of the animals are usually destroyed by the first poisoning treatment and the new plan of procedure contemplates follow-up applications of poisoned grain and carbon bisulphide or other fumigants to complete the work by the third year. In addition to several counties in western States which are now reported completely cleared of prairie dogs. many others have been cleared to a point where only an occasional prairie dog or ground squirrel can be found. Over enormous areas of farming land the repressive measures employed have made it possible for farmers completely to protect their crops from damage in regions where the loss had been excessively heavy and where in many instances it covered the entire crop.

The work is so organized and conducted as to make available to all farmers and stockmen supplies of poisoned bait at a moderate cost. Arrangements made by the bureau for the cooperative purchase of poisons in large quantities have greatly reduced the cost of these supplies. So far as local conditions make it practicable, field operations are being planned with a view to complete eradication over great areas to eliminate permanently the worst rodent pests. Operations will be extended from cleared areas as centers to prevent reinfestation. The work is being correlated along the borders of adjacent States for the purpose of protecting cleared areas in one State from reinfestation from adjoining lands in another. In regions where rodents are regularly extending their ranges they are attacked along the border of such extensions and pushed back. Western Arizona affords a good example of this kind, where the westward movement of prairie dogs was stopped by clearing an infestation on a front 75 miles long and 10 miles deep. Without this check there was serious danger of their spreading over into millions of acres of new territory.

In some instances county eradication campaigns reached the point where only a few rodents were to be seen, and there was a tendency for landowners to slacken in the work. A number of counties which failed to continue effectively the follow-up work suffered considerable reinfestation and came to a realization of the danger that the rodents might return to their former abundance and destructiveness. The work has been taken up again in earnest with a view to perma-

nent riddance of these destructive animals, and other counties are profiting by this experience. The lack of sufficient Federal funds to poison all Federal lands bordering on treated private holdings is seriously impeding the progress of the cooperative campaigns and this is becoming an increasing source of appeal on the part of landowners who have cleared their holdings and feel that they should be protected from reinfestation from public lands.

### POCKET GOPHERS.

Recognition of the damage wrought by pocket gophers in orchards and vineyards and in alfalfa and truck crop fields has brought about an increasing demand for operations against them. Successful completion of campaigns against the prairie dogs and ground squirrels in many counties has served as a stimulus to undertake the more difficult task of destroying pocket gophers. As these are burrowing animals, the damage to plants occurs chiefly underground and is often irreparable before the cause is noted. Knowledge of the actual damage being done by these animals and demonstration that it can be effectively controlled at a reasonable cost has led to extensive field operations against them during the year. Such operations have proved that these pests can be successfully eradicated through the use of various vegetable, grain, alfalfa, or clover baits treated with strychnine and properly placed in the runways, and by the use of traps of special design.

Work against pocket gophers has been undertaken on a considerable scale in Arizona, Colorado, Idaho, Kansas, Nebraska, New Mexico, Oregon, Texas, Utah, and Washington, and considerable demonstration work has been done in a number of other States. In Arizona notable progress has been made in eliminating pocket gophers from the citrus and date orchards, with the result that very few trees have been killed by these animals during the past year in such localities. Practically all orchardists in the citrus belt cooperated in treating their holdings with poisoned sweet potato baits. One orchardist who had lost over $10,000 worth of trees from pocket-gopher damage suffered no losses whatever this year, a result of the effective work done. In California it was found that the pocket gopher had gradually worked its way entirely around to the northern end of the Salton Sea and had made its appearance in the Coachella Valley. This presented a serious danger to the Government date gardens established there. As the pocket-gopher injury to a date palm is well concealed until the tree is permanently injured, it appeared advisable that work be done at once to check the infestation, and steps were taken to that end.

In the mountain parks and pasture ranges throughout the Rocky Mountain region pocket gophers are doing an extensive injury to grazing and hay meadows. The introduction of the promising head-lettuce industry into the mountain valleys of Colorado has made the work of controlling pocket gophers of far greater importance than formerly, and they are now looked upon there as one of the greatest pests.

In seven of the important alfalfa-producing counties of Kansas extensive operations against pocket gophers have been conducted. A test was made on 57,400 acres, and the results proved so satisfac-

tory that plans were laid to continue the work on a still larger scale during the coming year. Many alfalfa fields have been entirely freed of these pests and others have only an occasional animal where formerly there were large numbers. Chief reliance was placed on poisoned vegetable or grain baits, but large numbers of traps also were employed.

In Utah 40,254 acres of highly cultivated land were treated by the owners to destroy pocket gophers. This was undertaken after demonstrations were made and other educational work done to show landowners the proper way to use poison and after arrangements were made for them to obtain the required poison supplies in convenient form. In Sevier County, Utah, an interesting demonstration was made on an 80-acre field in which 78 acres were treated with poison at a total cost for labor and poison of $10. The following spring an examination of the field showed by actual count only 6 live pocket-gopher workings on the 78 acres that were treated, while on the remaining 2 acres which were left untreated as a check plot there were 15 live workings.

In Nebraska 53,870 acres were treated in a pocket-gopher campaign and 26 counties included pocket-gopher work in their farm bureau programs. In Oklahoma 480 pocket gophers were trapped on one 80-acre tract. An Oklahoma cooperator writes of the results accomplished as follows:

> It is hard to estimate the value of the pocket-gopher trapping which was done in my alfalfa fields last spring through increased yield, for the reason that there is not a similar field of alfalfa with which to make comparison, and to compare with last season is not fair because of the difference in growing conditions in the two seasons. From long experience as an alfalfa grower, however, I do believe that there is a sufficient increase in yield fully to justify the work to say nothing of the advantages the elimination of the pocket gopher gives to the harvesting of hay, which alone are worth the cost of exterminating them.

Much interest was shown in the eradication of pocket gophers along irrigation canal banks and in the intensively cultivated irrigated districts. This is due both to the direct damage which they do by feeding on the crops and to their burrows in the banks of the irrigation canals. These burrows frequently cause destructive washouts, entailing a serious loss of water, often at a critical period, and expensive repairs, and at the same time may damage the orchards and crops by flooding. Considerable work of this character has been done during the past year in cooperation with the Reclamation Service of the Department of the Interior and with water users' associations. A notable example of the benefits from work against pocket gophers is on the Elephant Butte Project, in New Mexico and Texas.

In Oregon pocket-gopher work was confined almost entirely to Polk County, where a clean-up campaign was inaugurated. Very general satisfaction is expressed with the results to date by most of the farmers in the district. Some of them report that there are absolutely no pocket gophers left on their land, and most of the others report one or two where there were formerly dozens or even hundreds. To complete the work some of this area still needs to be given a third treatment. To date, first treatment has been completed on 20,770 acres, and of this 18,395 acres have been given a second treatment and 8,800 acres a third. The work will be continued during the fall of 1923 on a larger scale.

Pocket-gopher campaigns in Idaho include work in eight counties, where more than 1,650 quarts of bait were used on about 78,000 acres and considerable trapping was done in connection with the poisoning operations.

### JACK RABBITS.

Great fluctuations in numbers characterize the occurrence of jack rabbits throughout their range. Relatively little work against them has been required during the past year. The very extensive poisoning and driving campaigns which were conducted in Idaho, Oregon, and Washington during the fiscal year 1922 resulted in such a marked reduction in their numbers that little damage has been reported since.

In Nevada, where serious damage has been done from time to time and extended poisoning campaigns have been conducted with good effect, it has been reported that jack rabbits were destroyed in large numbers by a disease and that they did relatively little damage. In Utah 334,000 jack rabbits are reported killed as a result of the campaigns which were conducted.

In limited campaigns organized in four counties in Idaho about 6,100 pounds of poisoned bait were used on 51,000 acres, and a few drives were also conducted. In Kansas, Montana, and Texas it is reported that jack rabbits are on the increase, and as considerable damage is being done locally, interest is awakening in the inauguration of control measures. Where these animals occur in large numbers they are capable of doing serious damage to growing crops, range grasses, meadows, hay in stacks, and to orchards and vineyards, but methods for destroying them on a large scale have been found.

### MEADOW MICE, PINE MICE, POCKET MICE, AND KANGAROO RATS.

Under favorable conditions the various kinds of native mice become excessively abundant locally, and, although small in size, collectively they do serious damage in orchards, gardens, and truck farms. During the previous year meadow mice appeared in destructive numbers in many of the important orchard sections of Idaho and Washington. Where these were foreseen in time the use of poisons recommended by the bureau prevented serious damage, but in many localities where such action was not taken the loss in trees was heavy. This situation emphasized the importance of foresight in dealing with local outbreaks of these small rodents.

During this year such outbreaks of orchard mice occurred in Yakima, Chelan, Okanogan, Grant, Douglas, and Kittitas Counties, in Washington, and necessitated control measures. A questionnaire sent to orchardists showed that in Yakima County 292 growers reported 4,598 trees girdled during the previous winter. In Chelan County a loss of 900 trees was reported. As the trees are from 1 to 15 years old, and valued at from $5 to $100 each, the importance of controlling the mice is evident. A general poisoning campaign was started the 1st of November, which is a very favorable time. Steamed-rolled oats proved a most satisfactory carrier of the poison. In this campaign 19,600 acres of orchard land were treated by more than 1,400 cooperators.

Based on reports received from orchardists, it is estimated that not less than $100,000 worth of trees were saved in the Yakima Valley as a result of these poisoning operations and that the combined savings for all counties would amount to not less than $250,000. One grower stated that he had "55 trees damaged before poisoning; none after poisoning; all damage stopped; value to me, $500." Another grower writes: "Poisoned as near 100 per cent as possible; believe every tree in my orchard (4,800) would have been killed." These statements are typical of many received from other orchardists. Trees once girdled have relatively little chance of complete recovery. Bridge grafting may save a good percentage, but the fruit is usually lost for a period of two years and the trees weakened to such an extent that often they blow over. The injured parts also afford harborage for insect pests, particularly the woolly aphis.

In Idaho, field mice were not very numerous during the past year and did damage in only a few communities. Poisoning operations were conducted in Ada County, where 480 acres of orchard were treated, 600 quarts of poisoned bait being used.

Pine mice continued to do much injury in orchards when the ground was covered with snow, and considerable loss of potatoes, sweet potatoes, and other root or tuber crops and flower bulbs was reported. The experiments conducted resulted in developing a much more effective poison preparation and in devising a simple and relatively inexpensive method of distribution. Very satisfactory protection was thus given to orchards, as the poison so distributed continues effective for a long period during the winter.

Pocket mice did a considerable amount of damage to grain in parts of Adams and Franklin Counties, Wash. A few farmers applied control measures, but relatively little work for the destruction of these rodents was undertaken, despite the fact that pocket mice can be controlled very easily.

In the control of kangaroo rats, which at times cause extensive damage to open ranges, a limited amount of assistance has been given landowners. In many instances, where infestation is heavy, kangaroo rats are a critical factor in determining the numbers of livestock that can be grazed on the area and interfere materially with natural reseeding by destroying quantities of seeds of native grasses. They also attack fields of sprouting grain and various vegetable crops. As a result of demonstrations given in El Paso County, Tex., several hundred pounds of oatmeal baits were distributed to protect the cantaloupes on irrigated lands. An expenditure of $30 in this instance saved several thousands of dollars worth of melons to the producers.

### WOODCHUCKS.

Many complaints of unusual abundance of woodchucks and damage by them have been received during the year from points throughout the northern United States. These animals not only damage garden vegetables, but also alfalfa, clover, and other valuable forage plants. Their burrows often cause erosion to start, resulting in the washing out of extensive gullies. Investigational work was conducted in the Eastern States with a view to determining baits and

poisoning or fumigating methods which would be effective in destroying these animals.

In the Northwestern States woodchucks did considerable damage to alfalfa and clover crops adjacent to the rocky ridges amid which they live. The most extensive campaign against them was conducted in Okanogan County, Wash., but some work was also done in Douglas, Grant, Kittitas, and Yakima Counties in the same State. It is estimated that about 19,000 woodchucks were killed there, affording protection to nearly 10,000 acres of crops and resulting in a substantial saving.

### HOUSE RATS AND MICE.

The bureau continued to furnish information through bulletins and special articles on the destructiveness of house rats and mice, the danger to health involved in their presence, and the practical methods possible for their control. This information has been very widely used by magazines, farm journals, and newspapers, and by educational workers and public-spirited citizens in bringing to the attention of individuals and communities the importance of applying direct, vigorous measures for the eradication of these pests. Two specialists of the bureau have been engaged during a large part of the year in demonstrating control measures through the extension services of the agricultural colleges and in assisting with the organization of antirat campaigns in States east of the Mississippi River. The entire force of rodent-control specialists employed by the bureau in States west of the Mississippi has also cooperated in a similar way in arousing interest in this important undertaking and aiding in the organization and conduct of campaigns looking to the eradication of these animals. In this way practically nation-wide attention has been given to the matter of getting rid of rats, and greater repugnance is being manifested to the presence of these pests and an intolerance of the waste due to their depredations.

Effort toward rat riddance has assumed larger proportions and more definiteness of procedure. It is coming to be recognized that the intelligent and persistent application of a few simple measures will serve to rid a farm or a community of rats. Experience has shown that rats can not long survive a concerted and sustained campaign against them. During the year the bureau has given particular attention to the working out of detailed plans of organization for use in large-scale operations. Looking to the permanent elimination of the rat pest, emphasis has been placed on the following features: Ratproof construction or repair of buildings; the closing of all openings which provide entrance for rats, including the screening of basement windows; prompt disposal of garbage and elimination of piles of trash and refuse where rats find food or harborage; the poisoning of rats with barium carbonate in barns, granaries, warehouses, and other buildings in which the use of poison is practicable; systematic trapping where for any reason the use of poison is inadvisable; the fumigation of rat burrows with carbon bisulphide or hydrocyanic-acid gas; the use of effective rat dogs; and the organization of community rat-killing drives. The plans of procedure which are being followed involve educational effort to arouse the public to a definite realization of the damage and danger involved

in the presence of rats and to stimulate definite operative measures for the exclusion and destruction of rats.

One of the most striking instances of an extended and well-organized antirat campaign was that undertaken during the year in the State of Virginia. Two specialists of the bureau cooperated with the extension service of the Virginia Agricultural College, including the county agents and home-demonstration workers. Other State agencies also joined actively in the undertaking. The governor issued a proclamation on the subject. The Virginia Department of Agriculture distributed campaign publicity. The Virginia division of markets put on an advertising campaign and assisted in numerous other ways. The State Board of Education carried the message of rat riddance effectively through the schools. The State Board of Health issued circular letters and other publicity matter. The State Farm Bureau Federation purchased and distributed all poison used, besides giving out much publicity and aiding the organized effort in many ways. The Virginia Bankers' Association sent out letters to all bankers within the State urging their cooperation and financial support. The Virginia Parent-Teachers' Association sent a letter to all local parent-teachers' associations urging their participation. The Cooperative Educational Association sent out circular letters urging cooperation. Other organizations, including the Farmers' Union, the State organization of Rotary Clubs, the Peanut Growers' Association, local chambers of commerce, farm bureaus, women's clubs, farmers' clubs, and many others entered heartily into the campaigns. Banks, farm bureaus, county commissioners, merchants, and many other organizations were liberal in financial assistance, and the newspapers of the State responded in a most gratifying and helpful way by giving many columns of space to the campaign propaganda. Valuable support came from the public schools, many of the campaigns being carried out almost exclusively through them.

Carefully compiled reports from the county agents of 71 counties in which the campaigns were conducted indicate that more than 500,000 rats were destroyed, and persons competing for prizes turned in 91,365 rat-tails; 158,198 people participated in the campaigns; 44,198 pounds of barium carbonate were distributed; 125,585 pieces of publicity material were circulated; 126,000 copies of poison directions, 10,000 posters, and 21,900 mimeographed letters and circulars were issued by the Virginia Extension Service; and prizes offered for rattails totaled $2,332 in value.

The total cost of the Virginia campaign was $7,444. As the average damage done by a rat in the course of a year is estimated at $2, the number of rats reported destroyed would represent a saving of produce and other property of more than a million dollars.

Important by-products of such campaigns are the interest aroused and definite action taken looking toward improved sanitation in individual homes, on farms, in villages, and in cities. The adoption of ordinances providing for the construction and repair of buildings with a view to the exclusion of rats and the improvement of sewage and garbage disposal frequently follow. The active and effective participation of the people of a community in such a concerted drive also cultivates a sense of community responsibility, a tendency to-

ward individual and community thrift, and a spirit of community teamwork that is far-reaching in its influence and helpfulness.

The development of the poultry industry in many sections of the country has brought a realization of the seriousness of the damage wrought by rats as destroyers of eggs and young chicks, and as possible carriers of avian tuberculosis. Much interest has been manifested in rat destruction by poultry producers, and special attention has been given by the bureau to meeting their requirements.

Investigations have been continued to improve methods of combating rats, including experimental studies of the effectiveness of various rat viruses on the market. Laboratory studies and field trials were made in cooperation with the Bureau of Animal Industry, and a number of agricultural college experiment stations also conducted bacteriological studies and laboratory tests of these products, all of which confirmed former conclusions that the use of poisons now available give more economical and effective results.

### MOLES.

Due to widespread complaints regarding damage by moles in lawns, gardens, truck farms, pastures, and hay meadows, the bureau has continued investigations designed to simplify and make more effective methods for combating these animals. Assistance has been given those who have reported damage due to moles by furnishing them, through correspondence, bulletins, or demonstrations, information on the most practical known methods for their control.

### PRODUCTION OF DOMESTIC RABBITS.

Inquiries continually come to the bureau regarding the production of domestic rabbits as a source of meat and fur. The bureau has kept in touch with officials of National and State organizations of rabbit breeders, and information has been furnished regarding the care, feeding, and management of these animals. Recommendations have been made, in cooperation with the Bureau of Agricultural Economics, regarding procedure which would afford the most satisfactory results in developing a market for the animals produced.

### FUR-BEARING ANIMALS.

Investigations regarding the rearing of fur-bearing animals in captivity have been carried forward vigorously during the past year, and progress of a very fundamental character has been made. The bureau has kept in close touch with those engaged in rearing fur-bearing animals, with dealers in raw furs, and with those engaged in dressing and dyeing furs and manufacturing fur products.

The formation of State and National organizations designed to serve the interests of the industry, to gather information regarding the progress made, and to establish an adequate system of record and registration has been encouraged. Most gratifying progress has been made along these lines. Encouragement has also been given to the enactment of legislation which would prove effective in the conservation of fur-bearing animals with a view to maintaining a permanent supply. In response to requests, assistance has been given a

number of States in revising existing laws or in framing new ones relative to protecting and rearing fur animals.

The active help of State game commissions, conservation societies, and the fur trade has been enlisted in conserving the wild fur bearers, since maintenance of a supply adequate to meet the requirements of the fur trade is of the utmost importance. An encouraging step was taken at the recent International Fur Exposition, held in New York City, where those assembled went on record as favoring the formation of a national association for the purpose of devoting considerable effort to the study of the problems of conservation as they affect the industry. The fur trade realizes that the future of the industry is dependent upon an assured source of supply of raw furs.

Fur farming is coming to be an important factor in the maintenance of the supply of fur-bearing animals and its development along sound lines is being encouraged. The number of persons engaged in the production of silver foxes in captivity is steadily increasing, and great interest is being manifested in this and other lines of fur production. Since the production of fur bearers in captivity is a comparatively recent enterprise it is not supported by the exhaustive research data enjoyed by similar industries of longer standing. Constant effort is being made by the bureau through its scientific investigations to obtain the information essential to the requirements of this growing industry.

Important progress has been made in studies of fur-bearing animals at the experimental fur farm at Keeseville, N. Y., including investigations of the prevalence of internal and external parasites of foxes, determinations of the age and seasonal susceptibility of the animals to infestation and their tendency to develop immunity toward such infestation, and experiments with remedial agents for the removal of parasites. Improved methods of administering remedies have been devised and valuable data have been secured regarding the tolerance of foxes to various medicinal drugs. Such information is essential to proper treatment at various ages and under different conditions of health and vigor. As a basis for clinical and diagnostic work studies have been continued of various features of the physiology of foxes, including the pulse, respiration, and temperature.

A number of fox farms were visited for the purpose of studying outbreaks of contagious disease, as fox influenza, which in some instances proved serious.

Experiments were continued with pens so equipped with concrete or board floors that they can be washed daily, to determine their effectiveness in preventing the infestation of foxes with internal parasites. Special attention was given to the use of these pens at the time of whelping and for care of the pups during the first few weeks, and they were found to be much better for use at whelping time than pens with earth floors.

A bulletin on silver fox farming, which reviews the history of fox farming and covers such essential features as suitable sites for a ranch, proper organization, and satisfactory practices in breeding, feeding, and management of foxes, was published during the year. As an indication of the interest in fox farming, it may be stated that applications were filed for a large portion of the original edition of 10,000 copies of this bulletin before it had left the press.

The chief fur expert of the Biological Survey made an extended trip among the blue-fox farms of Alaska during the early part of the year on the bureau's power cruiser *Sea Otter* and obtained valuable information which it is intended to publish in a bulletin on the blue-fox farming industry. In cooperation with the chief fur warden of the bureau and representatives of the Forest Service, he assisted in the organization of two associations of blue-fox farmers.

## FOOD HABITS RESEARCH.

### EXAMINATION OF STOMACHS OF BIRDS.

In the course of the fiscal year 2,302 stomachs of birds were received and incorporated in the collection, preparatory to examination. Laboratory work on the examination of various bird stomachs included 561 English sparrows, making the total examined for this species about 5,100. Examination of the stomachs of five species of shore birds has been completed and the data secured therefrom tabulated, preparatory to the preparation of a report on their economic status. In a continuation of a study of the food of birds of prey 331 stomachs and 248 pellets representing 10 species were analyzed. Considerable recently acquired material of fish-eating birds has been examined with the object of incorporating the data obtained in the manuscript previously prepared on the food habits of these birds. Additional material examined includes stomachs of band-tailed pigeons, studied in their relation to grain crops in California, and of domestic pigeons in relation to an imported snail now destructive in the vicinity of La Jolla, Calif.

In response to a request from persons in the Dominican Republic engaged in raising cacao, examination was made of two lots of stomach material of the "carpintero," a woodpecker having rather pronounced vegetarian habits. From the food preferences revealed it is apparent that this bird may become destructive to corn and the cacao, into the green fruit of which it drills holes to feed on the pulp. Other examinations made for correspondents included stomachs of ruffed grouse, from NewEngland; pileated woodpeckers and pigmy owls, from Oregon; several species of hawks and owls, chiefly from New York; crossbills, from Illinois; swifts, from Washington; and wild ducks, from Argentina.

### PINYON JAY CONTROL.

The status of the pinyon jay in its relation to grain crops was investigated during the year, and measures for control during the corn harvest were devised. Damage by the bird to wheat also occurs when it is in the shock, and the year's efforts were directed toward finding effective and economical means of control during that period. Experiments conducted in Colorado indicated that poisoning is only moderately successful during the wheat harvest and is economical only in small fields so situated that there is likely to be a concentration of jays in a limited area which can be baited. The great danger of killing mourning doves through poisoned baits placed in wheat stubble precludes the possibility of extensive poisoning campaigns against pinyon jays during the wheat harvest. Recommendation was made, therefore, that control measures for these birds be

conducted during the corn season wherever this crop is grown, and during winter wherever the birds congregate.

### RELATION OF GROUSE TO ORCHARDS.

During the winter of 1922–23 the bureau received complaints of depredations by ruffed grouse feeding on the buds of apple trees in several of the New England States. In New Hampshire the situation resulted in a public hearing being called at Concord, at which the Biological Survey was represented for the purpose of presenting data on the food habits and economic tendencies of these birds. From the information presented at this hearing and from other sources it is apparent that grouse have become very abundant during the past few years and under some conditions are inflicting damage. Reports to this effect have been substantiated by stomach examination of birds collected. History shows that the abundance of grouse runs in cycles of years, and it is believed that the present condition is temporary, and that a year or two will see a reduction in their numbers with a resultant decrease of damage.

### WILD-FOWL FOOD RESOURCES.

Continued progress was made in the survey of aquatic food for wild fowl, work being done in Maine, New York, Minnesota, Michigan, and Montana. Owing to the multitude of lakes in Minnesota, work in that State will have to be continued at least one more season before representative bodies of water in all lake regions of the State can be studied. In Montana 25 localities were investigated in carrying out a cooperative project, and as a result a report on the wild-duck foods of Montana was prepared for publication. In Michigan another cooperative piece of work was started in which local assistance was given investigators of the bureau in a survey of aquatic plant life. In Maine the waters of Lafayette National Park and a few lakes on the near-by mainland were surveyed. In connection with all this work recommendations for the improvement of the waters studied were made to interested persons.

### MISCELLANEOUS WORK IN ECONOMIC ORNITHOLOGY.

A preliminary investigation was made of the relation of pelicans to trout and other fish in Pyramid Lake, Nev. It is planned to make a thorough study of this problem during the next breeding season of these birds.

A special survey of Jekyl Island, Ga., was made, with recommendations for improving conditions for bird life in general.

Important additions have been made to the reference study collections of various kinds, all of which assist materially in the study of food habits. These included insects, mollusks, crustaceans, other invertebrates, and vertebrates of various kinds, as well as seeds and other plant structures.

A manuscript on the magpie in relation to agriculture, based on the examination of 547 stomachs, has been prepared. Its publication, however, will be delayed until the results of control experiments planned for the winter of 1923–24 can be incorporated in it.

Manuscript for a revised bulletin on bird houses also has been largely completed, along with a series of sketches illustrative of principles in bird-house construction. A circular on the various names by which migratory game birds are known locally is in press.

### WAR GASES AS BIRD-CONTROL AGENCIES.

Through a cooperative arrangement with the Chemical Warfare Service, experiments were conducted at the Edgewood Arsenal, Md., to determine whether some of the common war gases might be of use in the control of certain injurious birds, which for one reason or another do not lend themselves to poisoning operations. Use was made of the ample facilities for such work at the toxicological laboratory at the arsenal, and through the cooperative help of the laboratory staff extensive series of asphyxiation tests were made for the purpose of discovering a gas that would be lethal to birds, yet safe to use in agricultural sections.

English sparrows and domestic pigeons were used in the tests and were subjected, in varying concentrations and exposures, to the action of phosgene, "mustard," methyldichloroarsine, chloropicrin, chlorine, and bromocyanogen. A comparison of the results here obtained with the lethal dose for a dog (considered to approximate that for a human being) indicated that consistent results could not be expected against the birds in doses less than one-third of the lethal dose for man. In some instances birds survived after being subjected to a full lethal dose for a human being. Owing to the fact that such high concentrations are required, as well as to the factors of cost and the difficulty of handling, it is apparent that, with the possible exception of a limited use of chlorine or chloropicrin, the common war gases have no utility as bird-control agents. Chlorine and chloropicrin, as well as the others, can be released only in sections where their effect on vegetation would not be objectionable.

### FOOD HABITS OF REPTILES AND AMPHIBIANS.

Progress has been made in the study of the food habits of reptiles and amphibians, including the critical examination of 642 stomachs of toads, representing 19 species, from North and Central America and the West Indies. Important additions were made to the card-index files on subjects relating to food habits, behavior, life histories, and other general information regarding reptiles and amphibians. A mimeographed account of the common toad, including information on its range, life history, and economic status, was prepared. About 550 stomachs of amphibians were added to the collection, including 300 presented by Cornell University.

### EXAMINATION OF STOMACHS OF MAMMALS.

An examination of 85 stomachs of grasshopper mice was made and a report prepared on the food habits of these beneficial rodents. Approximately 380 stomachs have been added to the collection during the fiscal year.

## BIOLOGICAL INVESTIGATIONS.

As during previous years, the work of the Division of Biological Investigations has been conducted with the view of furnishing the basic scientific information needed for the proper administration of the various duties intrusted to the bureau—the enforcement of the migratory-bird treaty act and the Lacey Act, the management of big game and bird refuges, the numerous activities bearing on the conservation of game birds and mammals, and all the varied relations of birds and mammals to agriculture, forestry, and animal husbandry. Owing to the limitation of funds the biological surveys of States, as well as other field activities, have been curtailed. Progress has been made in adding to the files of information, mainly in the form of card indexes, on the distribution, abundance, and habits of North American mammals, birds, reptiles, and amphibians. These files, being an accumulation dating from the establishment of the bureau many years ago, now contain by far the largest mass of data on wild life in readily accessible form in existence. They comprise notes gathered from all available sources, including the field notes of the bureau staff, published accounts in books and periodicals, manuscripts from volunteer observers and friends of the bureau, and notes gleaned from correspondence and other sources. The value of the card catalogues is constantly increasing; they are in daily use to furnish information desired by other government departments, officials of State and municipal organizations, museums and other educational institutions, and individuals throughout the United States and in many foreign countries.

### BIOLOGICAL SURVEYS OF STATES.

Actual field work in connection with State surveys was confined to Wisconsin, Arizona, and Florida. In Wisconsin a field party worked during August and September in several widely separated sections, visiting a number of localities the fauna of which still needed investigation. In October an assistant visited the northwestern part of Arizona, completing certain field work required in that section of the State. Through the generosity of a naturalist friend of the bureau, who paid the expenses of an investigator, it was possible to make a survey of the bird and mammal life of a considerable area in central Florida during March, April, and May, thus adding materially to our knowledge of the distribution and breeding habits of the birds of that region. Several rare and interesting species were studied in the field and valuable original data obtained.

Progress was made also in the preparation of reports on the fauna of States. A report on the mammals of Wyoming was completed and one on the mammals of Oregon is partly completed. Reports on the birds and mammals of the State of Washington and of the birds of Florida are well advanced. Other reports already completed but awaiting publication include annotated lists of the mammals of New Mexico and North Dakota and of the birds of New Mexico and Texas.

### DISTRIBUTION AND MIGRATION OF BIRDS.

Bird migration reports were received from about 285 volunteer observers; a number of these have been sending in records from the same localities for more than 20 years, and a few as long as 30 years. The cumulative value of such series of records can scarcely be estimated. The card catalogue of the bird collection was brought up to date, and considerable work was done in rearranging the study collection of birds.

### BIRD CENSUSES.

Reports on the birds breeding on definite areas, usually selected as affording a variety of topographic conditions and different types of vegetative cover, numbered about 100, nearly double the number received during the previous year. Many of these involved areas which had been reported on during several previous years, thus affording an index to such local fluctuations in bird life as may have occurred. A publication on this subject, the third report on bird censuses in the United States, covering the period from 1916 to 1920, inclusive, was in press at the close of the year.

### BIRD BANDING.

The work of banding birds, as an aid to the study of distribution and migration, made material progress during the year. More than 25,000 birds were banded and the number of cooperators increased to 851, of whom 63 are in Canada. During the shooting season 668 returns of banded ducks were reported, which has added much to our knowledge of the seasonal movements of these important species. There has been a gratifying increase in the number of persons undertaking the operation of trapping stations, by means of which the best returns of the small nongame birds are obtained, and the results have been correspondingly satisfactory.

In October the Inland Bird Banding Association, formed to coordinate the activities of cooperators of the bureau in the Mississippi Valley, was organized in Chicago, the work of this organization being in a measure similar to that of the New England Bird Banding Association, which was formed in 1921. Plans have been formulated looking to the organization of similar regional associations covering the Atlantic seaboard and the Pacific slope.

An important feature of the year's progress has been the perfecting by a private firm of machinery which makes it possible to manufacture numbered aluminum bird bands cheaply and in large quantities, thus solving what has heretofore been a perplexing problem.

During the year two important field trips were made by an assistant for the purpose of banding ducks. The first expedition, covering most of October and November, involved trapping and banding ducks on an extensive scale on the grounds of the Sanganois Club, near Browning, Ill., where similar work had been done during the early spring of the same year. By means of traps of wire netting it was possible to capture and band over 1,300 ducks, including mallards, black ducks, and pintails. It is expected that many interesting returns will be reported during the fall shooting season. Another trip was made in January to Oakley, S. C., for the purpose of examining a proposed station for trapping and banding ducks. The con-

ditions seem to be favorable and it is believed that a productive station can be established there.

No official publications have been issued, but several articles on bird banding in ornithological periodicals have been reprinted in quantities and made available to collaborators through the generosity of an ornithologist who is much interested in this project. Addresses on the subject of bird banding have been made by representatives of the bureau at Camp Bradley, Md.; in Boston, Mass.; and in New York City.

### INVESTIGATIONS OF MIGRATORY WILD FOWL.

Investigations concerning the condition of migratory wild fowl have been carried on, mainly in cooperation with State officials, thus adding materially to our files of information concerning the distribution, migration, and breeding of these important game species, and serving an important purpose in the administration of the migratory-bird treaty act. Birds collected under scientific collecting permits during the calendar year 1921 have also been carded, bringing the data regarding this activity up to date.

It will be recalled that in 1922 concerted efforts were made by certain sportsmen, notably in Missouri, to be allowed a shooting season extending from February 10 to March 10, the contention being made that the birds were not mated during this period. In that year an investigation made by the bureau showed that mallards were paired as early as February 21, while specimens of both sexes taken early in March showed functional activity of the breeding organs. In order to gather additional data an assistant visited some of the more important wild-fowl resorts in Missouri frequented by these birds during the northward migration. The period covered was from February 20 to March 7, 1923, and the data thus obtained in southeastern Missouri concerned mallards, pintails, and hooded mergansers. Anatomical examination of specimens taken February 21 to 23 showed that many of the birds were in breeding condition. About 73 per cent of the mallards examined here between February 20 and 27 showed decided enlargement of the reproductive organs. Observations made at another locality in Missouri March 1 to 7 disclosed nearly similar conditions.

The participation of a representative of the bureau in the session of the American School of Wild Life Protection, held at McGregor, Iowa, in August, 1922, afforded opportunity for the presentation on a broad scale of the methods and policies of the bureau regarding the protection of wild life. Besides the influence exerted directly at these sessions, which were attended by sportsmen and game officials and many other persons representing organizations interested in the conservation of the wild-life resources of the Mississippi Valley, a number of short trips to near-by points were made in the interests of related projects. These included an inspection of a proposed game preserve near Garden City, Kans., and examinations of Clear Lake, near Mason City, Iowa, and Rice Lake, near Lake Mills, Iowa, localities formerly inhabited by considerable numbers of breeding wild fowl, and where it is desired to institute more effective protective measures. An examination was made also of the Winneshiek bottoms near Lansing, Iowa, in company with

Iowa and Minnesota officials, to determine the advisability of draining the area.

Another representative of the bureau, while investigating the condition of migratory wild fowl in North Dakota, with special reference to the breeding of wild geese, made an examination of the Chase Lake Bird Reservation. Reports of damage to shocked wheat by mallards in Kidder County, N. Dak., before the opening of the shooting season, were also investigated and found to be borne out by the facts. About the same time Island Lake, in Aitkin County, Minn., proposed as a game refuge, was thoroughly examined. It was found to be a comparatively small wooded island, and while its fauna and flora were found to be interesting, its establishment as a Federal game refuge was not considered desirable.

In April, a member of the staff, while investigating the distribution of birds and mammals in Florida, visited the Island Pond and Spruce Creek breeding rookeries near Maytown, and a series of rookeries on Sebastian River near Roseland, for the purpose of estimating the numbers of breeding herons, egrets, and ibises.

#### WILD LIFE ON NATIONAL AND STATE PARKS AND FORESTS.

An assistant of the bureau made an examination of the Grand Canyon National Game Preserve, Ariz., late in September and early in October, to obtain information regarding conditions affecting game, with special reference to making plans for disposing of the surplus deer on this refuge. Reports indicated that the mule deer on this preserve, the only large game there, had increased to such an extent as to overstock the ranges, especially in summer. The trip was a cooperative one, the Biological Survey representative being associated with officials of the Forest Service concerned with the administration of the Kaibab National Forest, within the boundaries of which the game preserve is located. Deer were found to be very abundant, it being estimated that upward of 20,000 were present. Late in March and early in April, 1923, another investigation was made of the region, the personnel including the same bureau representative and most of the same members of the Forest Service.

In general, the observations made on this trip confirmed the findings of the previous examination. Notable concentration of deer was observed in certain areas of bench land so situated topographically that movement of the animals to less crowded sections was difficult. While no suffering from lack of winter forage is yet apparent, excessive utilization of the summer forage is evident, as well as undesirable concentration on parts of the winter range, and it is believed that material reduction in the number of the deer is advisable, unless migration to less crowded areas can be induced.

Following the investigation of the Grand Canyon Game Preserve an examination was made, in cooperation with the National Park Service, of the Tonto Plateau, Grand Canyon National Park, to ascertain its suitability as a prospective preserve for antelope. The area was found to be fairly well suited to this purpose, except that it is considerably overgrazed by burros, the descendants of animals abandoned in the canyon many years ago. Since the burros serve no useful purpose, their removal or elimination is considered advisable,

and in case this can be accomplished, the successful establishment of a small herd of antelope is considered to be practicable.

A final examination was made of game conditions on the Wichita National Game Preserve and a report made to the forester with recommendations for handling the game there and for disposal of the surplus.

As a matter of cooperation in methods of administering parks and forests, with special reference to their wild-life resources, an assistant of the bureau attended the North Carolina Forestry Convention at Pinehurst, January 23 and 24, and the Third National Conference on State Parks, held at Turkey Run State Park, Ind., May 7 to 9, at each of which he delivered addresses on the relation of wild life to forests and parks.

### LIFE HABITS OF INJURIOUS ANIMALS.

Detailed experiments with captives of several species of injurious rodents, with special attention to breeding habits, were carried on during the year. The species studied included meadow mice, pocket gophers, kangaroo rats, pocket mice, grasshopper mice, and jumping mice. These studies disclosed many interesting habits hitherto unknown, especially with reference to the rapidity of breeding in certain species. These laboratory results admirably supplement field studies previously made on the same species and assist in interpreting habits imperfectly understood. Reports on the results of studies of meadow mice and grasshopper mice were prepared for publication. Intensive field studies also were made of certain injurious rodents in Washington and Oregon, especially mountain beavers, pocket mice, pocket gophers, and silver gray squirrels.

Late in October and early in November assistants of the bureau made an examination of the plots established in Arizona in cooperation with the Forest Service, the Carnegie Institution of Washington, and the University of Arizona, to determine quantitatively the damage effected on forage plants or stock ranges by certain rodents. These experimental plots are so arranged as to furnish data on the varying conditions of vegetation on fenced plots of uniform size, rodents of different species and cattle being given access or excluded to simulate the different natural conditions. A report on the results of a study of the feeding habits of prairie dogs and the quantitative damage to forage plants by these pests has been prepared for publication.

An intensive study of the habits of jack rabbits, with special reference to their economic status, has also been undertaken.

Early in October an assistant of the bureau, in cooperation with an official of the Bureau of Plant Industry, made a reconnaissance of Coachella Valley, Calif., as the first step in a proposed intensive study of the geographical and ecological relations of the fauna and flora of this region, which is believed to be potentially one of the richest agricultural areas in the State. Dates are the most important crop and their culture is being studied at the Government date garden, at Indio. Several native rodents are believed to be injurious to this crop. The time spent was too short to afford results of importance, but this preliminary survey gives promise of information of great practical value should it be possible to continue investigations there.

### INTRODUCTION OF TROPICAL AMERICAN GAME BIRDS.

For some years the Biological Survey has been interested in having experiments made for the introduction and acclimatization of the ocellated turkey, a wonderfully beautiful game bird found from Yucatan to Honduras, and the curassow and possibly other game birds of the same region. In the spring of 1923, a cooperator of the bureau provided the funds needed to send a naturalist to the Lake Peten region of Guatemala to secure a stock of living birds for this experiment, the birds when received to be placed on islands off the coast of Georgia. The leader of the expedition reports that a considerable number of young ocellated turkeys and other birds are being raised for this experiment by Indians under his supervision.

### INVESTIGATION OF INTRODUCED QUAIL.

Within the past eight years large numbers of quail, or bobwhites, have been introduced into Pennsylvania and Maryland from northern Mexico in an attempt to replenish the depleted covers. These birds belong to a form which differs from the native birds in smaller size and paler or grayer coloration. It is a matter of much interest to ascertain to what extent the introduced birds have increased and whether they interbreed with the native stock. To obtain these data a representative of the bureau, in cooperation with members of the State game commissions, during the hunting season visited the sections of those States affected by the introductions and collected specimens from as many coveys as possible. The results showed that interbreeding between the imported and the native stock had taken place in a number of instances, while a few birds which showed only the characters of the imported birds may have been either members of the original importations or their descendants. This investigation will be continued, as the results will have a practical bearing as well as a scientific value.

### HAWAIIAN ISLAND EXPEDITION.

Some years ago a German living on Laysan Island, a celebrated breeding place of enormous numbers of albatrosses and other notable sea fowl, and within the Hawaiian Islands Bird Reservation, introduced the European rabbit. The multiplication of these animals on this wonderful island made it evident that they must be exterminated if the vegetation and some of the species of birds peculiar to the island were to be saved. In the spring of 1923, through the cooperation of the Navy Department, a vessel of 1,000 tons capacity was detailed for four months to provide facilities for a careful scientific reconnaissance under the direction of a representative of the Biological Survey of all of the islands in the Hawaiian Islands Bird Reservation and others adjacent thereto, including Wake and Johnston Islands. Through the active cooperation of the Bishop Museum, of Honolulu, the scientific personnel of the expedition included a botanist, an entomologist, an anthropologist, a geologist, and other scientists. The present survey of these islands is one of the most complete ever undertaken in the Pacific.

Word has been received that the rabbits have now been exterminated on Laysan, although before the arrival of the expedition they had almost completely destroyed the vegetation. Plants and seeds were subsequently obtained in Honolulu and planted on Laysan, where undoubtedly vegetation of a more varied character than heretofore will flourish. One of the interesting results already reported is the finding about this and other islands of considerable numbers of the little-known Hawaiian seal.

## ALASKA INVESTIGATIONS.

### REINDEER.

At the beginning of the bureau's reindeer investigations, in 1920, the reindeer experiment station was established at Unalakleet, on the shore of Norton Sound. By July 1, 1922, the work had developed to a point that made it advantageous to move the station to Nome, where there is a more suitable building, with a barn and corral for conducting experiments.

#### FEEDING EXPERIMENTS.

In order to conduct feeding experiments, in the fall of 1922 seven reindeer—four adults and three fawns—were procured from a Government herd located 25 miles from Nome and brought to the experiment station. Until the animals became accustomed to their new quarters they were fed reindeer moss. Later moss was mixed with other feed, and finally eliminated altogether. Only about 15 days were required to wean fawns completely from the use of moss, but it took much longer for the adults. The feeding experiment proved very successful and was one step toward demonstrating the possibility of utilizing reindeer far more extensively in travel and winter transportation than is now being done. Further experiments will be conducted to determine the quantity of forage necessary each day for a sled animal traveling long distances. As carrying space on sleds is at a premium on long trips, the weight and bulk of food necessary to be taken along for sled animals is of prime importance.

#### GENERAL OBSERVATION WORK.

The bureau's auxiliary power schooner *Hazel*, used for reindeer investigational work on the Bering and Arctic coasts, traveled a total of 3,573 miles during July, August, and September, proceeding south to the town of Bethel, on the lower Kuskokwim River, and north to Kotzebue Sound. These cruises were made for the purpose of investigating the condition of the herds and for studying the herds and methods of herd management. At the same time educational work was undertaken with the herd owners for the purpose of introducing improved management, which is already showing results, especially in methods of castration, in branding, and in the handling of herds on the range. Collections made of forage plants and the studies of their abundance and distribution supply invaluable information necessary for the wise allotment of grazing areas to herd owners when such allotments are authorized by law.

RANGES.

Careful investigations were made of the kind and distribution of forage plants and of the grazing capacity of the reindeer ranges over a large area. The vital importance of this investigation has become evident since it was learned definitely that in winter reindeer are almost entirely dependent on reindeer moss. This involves the necessity of providing summer and winter grazing areas for each herd, in which the "moss" or winter areas must be larger than those for summer, when grass and other ordinary herbage is eaten. This fact has necessitated a change in computing the grazing capacity of reindeer ranges from a basis of 30 acres per animal to from 40 to 60 acres. On this new basis it is estimated that Seward Peninsula alone would carry approximately 200,000 head.

CARIBOU INVESTIGATIONS.

The field naturalist with headquarters at Fairbanks continued his investigations of caribou during the year and obtained much valuable information during an extended winter trip through the Endicott Range country and back to Fairbanks by way of Fort Yukon.

INVESTIGATION OF REINDEER INDUSTRY IN NORTHERN EUROPE.

The investigation of the reindeer industry in northern Europe, conducted in August and September by the bureau's former chief specialist in the reindeer investigations in Alaska, proved not only very interesting but of much value in its relation to the reindeer investigations now being made. The Norwegian reindeer were found to be smaller than the Alaskan animals, and less fat, both characteristics probably being due to the depleted ranges. The heaviest reindeer were found in Lapland. In Norway reindeer were found to be very healthy as a rule and less attacked by warble flies than in Alaska, the constant moving of the herds being given as the cause for this freedom from parasites. The frequent moving of herds recommended by the bureau's experts in Alaska in 1921 is now being followed by many herd owners in the Territory, with beneficial results.

PROTECTION OF LAND FUR ANIMALS.

Some progress has been made in the work of protecting land fur animals in Alaska, but not so much as is desirable, owing to the inadequate law and to the limited funds available for the purpose. The practical value of educational work to emphasize the need of better conservation of both the game and fur animals of Alaska is shown by the rapid growth of favorable sentiment in the Territory and by an increasing appreciation of the work being done along these lines by the bureau.

The only important change in the fur regulations during the year related to the protection of blue foxes, and was made at the request of the blue-fox farmers in order to prevent poaching, an evil practice which was becoming a serious menace to the industry. This regulation, promulgated on January 9, prohibits the killing of blue foxes at all times in district 1, except on the Aleutian Islands Res-

ervation, and in district 2, south of latitude 62°, with the exception that the duly authorized agents, owners, lessees, or permittees of islands and lands used and maintained as fur farms for the propagation of blue foxes may kill at any time the animals in their possession.

A fur warden was appointed at Nome, and warden service was maintained during parts of the year at Fairbanks, Unalaska, Anchorage, Juneau, Cordova, and Belkofsky. Excellent cooperation was given by the customs division of the Treasury Department and by agents of the Department of Justice. Plans have been made for extending fur-warden service by the appointment of regular wardens for the Kuskokwim region and for that about Fairbanks.

The fur warden stationed at Nome made a careful investigation of conditions in regard to fur-bearing animals along the Kuskokwim River early in 1923, traveling a total distance of 1,603 miles by dog team and going as far south as Bethel. Valuable information was obtained regarding land fur animals, one important fact being noted that, with the possible exception of the beaver and the marten, the fur bearers were more than holding their own. Serious forest fires, however, have ruined many miles of marten territory in the Kuskokwim region. The establishment of a Forest Service fire patrol in interior Alaska is seriously needed and will be of enormous value to the future welfare of the Territory. Fires annually destroy vast areas of timber valuable for local use and forage for game and reindeer that can not be replaced in many years.

### PROSECUTIONS AND SEIZURES.

Only two arrests were made for violations of the fur law, each resulting in a conviction and fine. A number of contraband skins were seized, but the possessors were not prosecuted, owing to defects in the fur law which make successful prosecution doubtful.

Reports of the use of poison and explosives in the destruction of beavers, their dams, and their houses continue to be received and present the most serious danger to the future of the fur animals that exists. So many beavers were killed during the recent open season that a general desire has been expressed by people from all parts of the Territory for another extended close season.

With an adequate fur law and sufficient funds to enforce it, proper protection could be given to the land fur-bearing animals of the Territory, and thus perpetuate and increase one of its most valuable natural assets.

### SHIPMENTS OF ALASKA FURS.

Shipments of furs from the Territory continue to form an important item of its annual production. According to reports made to the bureau by postmasters and agents of transportation companies, covering the year from December 1, 1921, to November 30, 1922, the number of furs shipped greatly exceeded that for the previous year. Only 254,788 skins were shipped during the year ended November 30, 1921, while 394,514 were shipped in 1922. Exclusive of white and blue foxes of the Pribilof Islands, which are under the jurisdiction of the Bureau of Fisheries, the value of the skins of land fur bearers shipped for this year amounted to $1,732,693. The number of the principal pelts shipped and their value were as follows:

| Kind of fur. | Number. | Value. | Kind of fur. | Number. | Value. |
|---|---|---|---|---|---|
| Muskrat | 313,145 | $391,431 | Beaver | 12,216 | $250,587 |
| Blue fox | 1,080 | 118,800 | Land otter | 1,899 | 43,677 |
| White fox | 4,393 | 175,720 | Mink | 31,983 | 223,881 |
| Red fox | 5,979 | 110,611 | Marten | 10,385 | 285,587 |
| Silver-gray fox | 291 | 58,200 | Weasel (ermine) | 10,656 | 9,057 |
| Cross fox | 740 | 29,600 | Black bear | 751 | 10,138 |

As a considerable number of furs are used in Alaska and as many are taken out by travelers and by vessels not reporting them, it appears safe to estimate the take of land furs for the year as exceeding a value of $2,000,000, or a 6 per cent return on a capital valuation of about $33,000,000 for this natural resource.

### GENERAL ACTIVITIES.

The bureau's seagoing power boat *Sea Otter* has been used continually, patrolling waters and streams of southeastern Alaska, and visiting fur-farming islands and many other points to enforce the fur laws and to enable the chief warden to be of increased practical assistance to the fur farmers. The chief fur warden and other employees of the bureau in Alaska are encouraged to conduct a persistent educational campaign for the better conservation of the fur and game resources of the Territory. Most gratifying results have been obtained in a way that holds out great encouragement for the future.

### FUR FARMING IN ALASKA.

During the summer and early fall of 1922 the chief fur warden and the chief fur-farming expert of the bureau made a trip on the *Sea Otter* from southeastern Alaska to Unalaska, studying the fur farms and other matters relating to fur production. The results of this are mentioned earlier in this report under the general subject of fur farming. The fur-farming industry in Alaska appears to have a most promising future.

All but one of the ten islands under the jurisdiction of the bureau for leasing for fur-farming purposes have been leased. It is not considered advisable to grant an exclusive lease on the remaining island.

Fox farming, mainly of blue foxes, is developing rapidly and appears to have a good future in the Territory. Two associations of fur farmers were formed in the fall of 1922, one at Cordova and the other at Petersburg. A list of blue-fox farmers of Alaska with their names, post-office addresses, and the name of the island occupied by each has been prepared and distributed in mimeographed form by the bureau, showing that there are now 99 blue-fox farmers in southeastern Alaska, 29 in the Prince William Sound region, 8 in the Lower Cook Inlet region, 13 in the Kodiak-Afognak region, and 10 on islands off the Alaska Peninsula, or a total of 159. In addition there are about 20 blue-fox farmers in the Aleutian Islands Reservation, while 25 permits have been issued to residents of Alaska to capture alive beavers, minks, martens, and muskrats for propa-

gating purposes. All possible encouragement is given responsible parties who have favorable locations to engage in this new enterprise.

One handicap to the development of the fur-farming industry in Alaska is the lack of authority in any governmental agency to lease the numerous islands which are suitable for the purpose but which are located outside the national forests and the Aleutian Islands Reservation.

### PROTECTION OF ALASKAN GAME.

The Alaska game law is administered by the Governor of Alaska under regulations promulgated by the Secretary of Agriculture. Migratory birds in the Territory are protected under the provisions of the migratory-bird treaty act.

The most important change in the regulations during the year in regard to game in Alaska was the elimination of specific protection of deer on Duke, Gravina, San Juan, Suemez, Zarembo, Hawkins, Hinchinbrook, Montague, Long, and Kodiak Islands. Kruzof Island, near Sitka, alone in southeastern Alaska, remains a deer preserve. It is forbidden, however, to kill deer anywhere west of longitude 141°, thus giving this game protection on all islands in that region.

### DESTRUCTION OF WOLVES IN ALASKA.

For some years requests have come from citizens of Alaska that efforts be made to destroy wolves, which have been enormously destructive to deer on the coastal islands of southeastern Alaska. Local residents had made efforts for a long period to destroy wolves in that region, and the impression was general that, because of unusual topographic and climatic conditions, these animals could not be successfully destroyed. Our representative working in Michigan was detailed to Alaska for two months, where he demonstrated beyond question that it was not only feasible to trap and poison the wolves successfully on the Alaskan islands, but that it would not be a very difficult matter to exterminate them on most, if not all, of the islands. Thirty large timber wolves were taken by traps or poison, and no doubt, as is usually the case, numerous others killed by poison were not found. The results were so promising that this work will be continued. Destruction of the wolves will be extremely helpful in increasing the numbers of the deer, which are so important a factor as a part of the food supply of the Indians and other residents of that region.

## GAME AND BIRD REFUGES.

The continual increase in the number of hunters and the decrease of various species of game are producing a healthy reaction among sportsmen and others interested, causing the establishment of State game refuges. The number of such refuges in a list compiled by the Biological Survey in 1922 was 423, of which 346 contained a total of more than 19,331,000 acres. To these, early in 1923, the legislatures of 12 States added 38, with a total of 3,000,000 acres. Among those of notable interest are several refuges made in Nevada, mainly for the benefit of antelope.

The Shoshone and Pathfinder Federal refuges on irrigation projects in Wyoming were abolished during the year, as they had proved to be of too little value to be retained. This leaves a total of 68 Federal bird and big-game refuges administered by this bureau.

### BIG-GAME REFUGES.

During the last part of June the 12-mile big-game fence which had been under construction at the Niobrara Reservation, near Valentine, Nebr., for several years was completed. It incloses approximately 4,000 acres of ideal range for big-game animals adjoining the two small areas heretofore available for this purpose.

The winter of 1922–23 was a comparatively mild one in the West, enabling game in general to come through in satisfactory condition. The increase in game animals on the refuges was satisfactory, the one item of disappointment being the misfortune which overtook the antelope herds on the Bison Range and the Wind Cave Refuge. The difficulty of maintaining and building up herds of antelope is in striking contrast with the ease attending the increase of herds of other game animals. Buffalo, elk, mule deer, and white-tailed deer appear to be as hardy and to breed as freely on game refuges as ordinary domestic stock. They are at the same time surprisingly free from diseases.

No damage by fire was done to any of the refuges during the year.

The following table shows the number of big-game animals on the refuges under the jurisdiction of this bureau at the close of each calendar year from 1916 to date, the figures for 1923 being as reported up to June 30 only:

| Kind of game. | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|
| Buffalo | 206 | 251 | 311 | 381 | 431 | 508 | 603 | 717 |
| Elk | 165 | 205 | 261 | 345 | 433 | 519 | [a] 608 | [a] 657 |
| Antelope | 47 | 57 | 55 | 54 | 65 | 91 | 21 | 16 |
| Deer, mule | 2 | 2 | 15 | 21 | 27 | 54 | [a] 52 | [a] 62 |
| Deer, white-tailed | 3 | 6 | 8 | 9 | 5 | 21 | [a] 31 | [a] 27 |
| Mountain sheep | | | | | | | 15 | [a] 20 |
| Total | 423 | 521 | 650 | 810 | 961 | 1,193 | 1,330 | 1,499 |

[a] Estimated.

The distribution of the 1,499 big-game animals shown in the last column above on reservations under the jurisdiction of the Biological Survey was as follows:

| Kind of game. | Bison Range. | Wind Cave. | Niobrara. | Sullys Hill. |
|---|---|---|---|---|
| Buffalo | 549 | 107 | 48 | 13 |
| Elk | [1] 400 | [1] 170 | 57 | 30 |
| Antelope | | 16 | | |
| Deer, mule | [1] 60 | 2 | | |
| Deer, white-tailed | [1] 20 | | 2 | 5 |
| Mountain sheep | [1] 20 | | | |
| Total | 1,049 | 295 | 107 | 48 |

[1] Estimated.

*National Bison Range, Mont.*—By far the most disastrous occurrence in connection with this refuge was the final extermination of the remnants of the herd of 60 antelope that was on this range early the preceding year. The antelope were killed by predatory animals which came in from the surrounding country during severe winter weather, probably assisted by Indian dogs from the reservation near by. During several years hunters have been detailed to destroy predatory animals in and about this and the other game refuges, and large numbers have been thus killed. The destruction of antelope here and at Wind Cave is good evidence of the difficulty of protecting game refuges from the inroads of coyotes or other predatory animals, which are able to travel great distances during a single night. Antelope appear to be peculiarly helpless before such danger, the losses of other game animals from this source in the same refuge being negligible.

The rapid increase of buffalo and elk on this range has about stocked it to capacity, as is shown by indications of deterioration in the range here and there. As a consequence, it has become necessary to provide for the disposal of surplus animals. Negotiations looking to this were initiated during the last part of the year.

The buffalo on the preserve now number 549, including 92 calves of the year. Only three deaths took place in the herd during the year. It is estimated that there are about 400 elk in the herd, including about 60 of this year's calves. So far as known, only two elk, both young bulls, died during the year. The mule deer, white-tailed deer, and mountain sheep are all doing well. It is estimated that from 50 to 60 beavers live along Mission Creek within the reservation.

The number of game birds on the refuge is estimated to include about 400 sharp-tailed grouse, 50 blue grouse, 50 Hungarian partridges, 100 Chinese pheasants, and 200 mallard ducks. During mild weather in the last part of February 12 Chinese pheasants in excellent condition and apparently preparing to mate appeared about the headquarters corral. These introduced birds appear to have become well established on the refuge, and with other game birds will serve to supply a surplus to sportsmen in the country surrounding the fenced area.

A number of needed improvements were added during the year, including a reservoir 130 feet long, 30 feet wide, and 4 feet deep; a frame cabin, known as "The substation"; an ice house; four small outbuildings; and three poison and trapping stations for predatory animals. Many old posts in the game fence were replaced or reset, and two floodgates crossing Mission Creek were rebuilt to prevent the animals from escaping.

*Wind Cave Game Preserve, S. Dak.*—Coyotes had reduced the antelope herd on this refuge by early spring from 21 to 8 does. By June 30 these were accompanied by an equal number of fawns, making a total of 16. In order to protect them a number of poison-bait stations were established and a vigorous campaign was put in effect and will be continued to destroy the predatory animals in and about the refuge. As in the case of the Bison Range, the surrounding country is inhabited by coyotes and other game-killing animals, which frequently travel great distances. Consequently it will be possible to maintain antelope here only with unceasing vigi-

lance. The buffalo and elk are in excellent condition and have increased to a point that necessitates the disposal of a number of each in order to prevent the range from becoming overstocked.

Evidence of the unexpected aggressiveness of bobcats on the game was found when a warden trailing an antelope during a winter snowstorm discovered that a bobcat had joined the trail a little ahead of him. A short time later he came on the carcass of a full-grown antelope that had been killed by the cat just before the warden arrived. A large number of coyotes have been destroyed in and about this refuge.

*Niobrara Reservation, Valentine, Nebr.*—The large game animals on this refuge up to the end of the present year have been maintained in two small inclosures. Several years ago the inclosure of an additional 4,000 acres of excellent range land for game was undertaken and was completed at the end of the present year. Later in the season game will be transferred to it. A number of beavers live along the river on this refuge, but how many is not known.

Quail were more numerous here during the spring of 1923 than at any other time within the past seven years. About 300 pairs of prairie chickens and sharp-tailed grouse nest along the southern side of the refuge, and in winter others move into the shelter from the more open country on the north side. Many ducks remain along the river on the refuge during winter, when at times several hundred are present.

*Sullys Hill Game Preserve, near Devils Lake, N. Dak.*—The hostess house for visitors to this refuge and 1 mile of 6-foot fence which keeps the buffalo and elk from Sweetwater Lake, were completed, thus making the refuge a pleasanter place for the public to visit. This refuge continues to be a popular place for picnic outings for people of Devils Lake and the surrounding region, the total number of visitors during the fiscal year being 6,079, as follows: July (1922), 2,931; August, 1,321; September, 514; June (1923), 1,313.

The numbers of animals on the refuge on June 30 were as follows: Buffalo, 13; elk, 30; white-tailed deer, 5; a total of 48. Shipping corrals were built for the purpose of readily crating and transporting surplus elk. Unfortunately, severe weather conditions developed before shipments could be made, and a number of the elk perished. The buffalo came through the winter in excellent shape.

*Winter Elk Refuge, Jackson, Wyo.*—The early winter was comparatively open, with light snowfall, thus leaving the pasturage accessible to the game. About 3,400 elk were fed on the two feeding grounds, of which 3,000 or more came in early in the year and about 400 came in in small parties at different times. They remained in good condition throughout the season and the loss was comparatively light.

Feeding the elk started on January 23, after a snowfall of 21 inches, and continued until April 25. Very satisfactory results were obtained by the construction of feeding corrals for the elk calves, so arranged with low, narrow entrances, called "creeps," that the calves could enter to feed free from molestation by the larger animals. This method of feeding was so successful that it will be continued on an extended scale during the coming winter. It is certain that this will result in saving a large number of calves that would have died, as

formerly, from being pushed about and worried by the large animals on the general feeding grounds.

At the commencement of winter the bureau had on hand a little less than 1,000 tons of hay, of which 686 were raised on the refuge, the remainder being purchased from neighboring ranches. In addition, the grazing privileges were rented on 400 acres of bottom lands. At the end of the season 85 tons of hay remained on hand.

In order that the refuge may be made to produce the maximum of hay a tractor with plows and other implements has been purchased and an increased annual acreage will be tilled until the entire range is producing.

Much of the fencing about this refuge is now old and in such condition that it must be replaced in the near future. Other improvements are also greatly needed.

### BIRD REFUGES.

*Flat Creek Bird Refuge, Wyo.*, covering 40 acres in the valley bottom adjacent to the winter Elk Refuge at Jackson, was established by Executive order of September 29, 1922. Although this is a small area it is used extensively by migratory wild fowl not only during the nesting period and migrations but also throughout the winter months. The area contains springs which keep it open throughout the winter and afford plant and insect food which sustain the resident ducks during the cold season. Its situation adjacent to the Elk Refuge adds additional pasture for the elk herds.

*Belle Fourche Bird Refuge, S. Dak.*—Conditions on this refuge were, as formerly, unsatisfactory, owing to the continuous grazing on lands immediately adjacent to the lake shore, without which nesting birds might take advantage of the cover. Fencing has been built for the purpose of eliminating livestock from this portion of the refuge. The excellent result from this has become apparent and it is planned to increase the protected area in order to attract additional nesting birds.

*Big Lake Bird Refuge, Ark.*—This refuge is notable as a resting and feeding place for wild fowl during both spring and fall migrations. Through the excellent support given the wardens by the District Court of the Eastern District of Arkansas in the protection of this refuge the people of the region now respect it and look upon it as a distinct local asset. A warden's house has been built on the highest point of the refuge near the principal hunting and trapping grounds, and is an improvement which renders the control of the lake much more effective. In order to prevent undue disturbance of the wild fowl, trapping of fur-bearing animals on this refuge is allowed only under permit, the trappers not being permitted to visit their traps before sunrise or after sunset. Refuges of this character are exceedingly important in giving migratory wild fowl resting places during their journeys north and south. With the drainage of many other water areas such places are becoming more and more valuable for the purpose for which created.

*Lake Malheur Bird Refuge, Oreg.*—A compromise agreement proposed by representatives of the State of Oregon and of the Biological Survey as to the future status of this refuge was not consummated, and the matter still remains for adjustment. Ravens are so abundant

in this district that they are becoming a menace to the welfare of the wild fowl breeding there and must be reduced in numbers. Serious depredations by them on the bird life, particularly during the breeding season, call for active measures against them, and these will be taken during the coming winter.

*Salt River Bird Refuge, Roosevelt, Ariz.*—On August 8, 1922, the Secretary of Agriculture issued an order permitting the hunting of migratory wild fowl on the eastern arm of Roosevelt Lake within this refuge. This will give a limited amount of hunting in a region where opportunities for this sport are exceedingly scarce, but will not seriously interfere with the welfare of the birds.

## MIGRATORY-BIRD TREATY AND LACEY ACTS.

The helpful effect of the migratory-bird treaty act in increasing the supply of migratory wild fowl continues to impress all observers and to make friends for this legislation from its former opponents. Unfortunately, the progress of drainage of fresh-water marshes and lakes goes on rapidly, and unless enough of these areas can be perpetuated to afford feeding and breeding grounds no hope can be held out for the maintenance of the supply of these fine game birds. During the year representatives of the bureau have assisted State game commissions and other conservationists to protect several fine wild-fowl water areas from drainage, notably Swan Lake in Minnesota and the Winneshiek Bottoms on the upper Mississippi.

### COOPERATION.

The Biological Survey is deeply indebted to State game officials, conservation organizations, and sportsmen from practically every State for the fine spirit of cooperation extended by them, not only in the enforcement of the law but in influencing public opinion for its observance. Much effort has been made to build up and maintain this cooperation, to which so much of the success achieved in increasing our migratory wild fowl is directly attributable.

### WARDEN SERVICE.

Approximately 28 full-time United States game wardens were on duty through the year, aided by about 400 cooperative deputy wardens. Of the last, 35 were placed on per diem duty during short intervals in emergencies. Cooperative wardens receive a nominal salary of $1 per annum, except when placed on active duty, when they receive $3.50 a day with an allowance for expenses.

Shortly after he entered the service and while in the performance of his duty, United States Game Warden Edgar A. Lindgren, of Council Bluffs, Iowa, was brutally murdered by two Italians on August 13, 1922. A United States attorney assisted the State authorities in the prosecution of the assassins, who were convicted in the State court and sentenced to life imprisonment. Several other Federal game wardens also were feloniously assaulted while in the discharge of their duties, one with a loaded firearm, but fortunately they were not seriously injured. The frequent occurrence of these assaults on Federal wardens again demonstrates the great need of a

Federal statute under which assailants of Federal officers engaged in the discharge of their duties may be adequately punished.

### STATE HUNTING LICENSES.

Incomplete returns show a substantial increase in the number of hunting licenses issued in some States and a small decrease in others. Reports received indicate that the total number issued in the United States probably exceeds 4,000,000, approximately the same number as issued the preceding year. In addition, under a legal authorization, nearly half as many people hunted without a license.

### MIGRATORY-BIRD TREATY-ACT ADVISORY BOARD.

The migratory-bird treaty-act advisory board held its annual meeting in Washington on December 14 with 16 of the 22 members present. A number of amendments to the Federal regulations suggested by the bureau were considered by the board, and its recommendations were very helpful to the department in reaching its decisions on the advisability of making changes in the regulations. The meeting of this board each year is of great service to the bureau also in giving an opportunity to confer with State game officials and other conservationists among its members regarding migratory wildfowl conditions throughout the country and the effect of the policy of the department in maintaining the supply of these valuable game birds.

### MATING HABITS OF MIGRATORY WATERFOWL.

Supplementing its investigations of last year to determine the earliest mating dates of wild ducks in the Mississippi Valley regions, the bureau this year again assigned an assistant biologist to investigate mating and breeding habits of wild fowl in Missouri, as stated earlier in this report. Last year his investigations were confined mainly to the northern part of the State, but this year they extended into the southeastern sections, where the mating of wild ducks was found to be well advanced as early as February 21. The data thus gathered are of the utmost value, in view of the demand still being made for the privilege of hunting wild fowl in Missouri and certain other States later in the winter than January 31.

### PERMITS TO KILL MIGRATORY BIRDS INJURIOUS TO PROPERTY.

Under regulation 10 of the migratory-bird treaty-act regulations the Secretary issued orders during the year permitting employees of the State Conservation Commission of Wisconsin to kill great blue herons and authorizing State game wardens of Idaho to kill mergansers and great blue herons when these birds are found injurious to fish. In addition, growers of small fruits in Connecticut, Idaho, and Washington and members of their immediate families and their bona fide employees were given permission to kill robins found injuring cherries or other small fruits from May 16 to September 30. Permits for this purpose were already valid in Colorado, Indiana, Minnesota, New Hampshire, New York, Oregon, and Wisconsin. These orders provide that robins may be killed only when committing or about to commit serious injury to growing cherries or

other small fruits, and only by the holders of permits countersigned by the chief official in charge of the enforcement of the fish and game laws of the State in which the order is effective. Permits are revocable in the discretion of the Chief of the Bureau of Biological Survey or of the person countersigning them.

### VIOLATIONS OF THE MIGRATORY-BIRD TREATY ACT.

At the beginning of the fiscal year, migratory-bird treaty-act cases to the number of 722 were pending before the courts, and during the year there were 693 new cases reported for prosecution. Of these 1,415 cases, 472 were disposed of by convictions, 28 were nolle prossed, in 2 the grand jury did not return true bills, 99 were dismissed, 3 were terminated by the death of the accused, and in 8 the jury returned a verdict of not guilty; the remainder are pending.

The total revenue collected during the year in all cases amounted to about $8,650, the fines ranging from $250 to $1 each. In numerous instances the defendants were also required to pay the costs, which in some cases equaled and in others exceeded the amount of the fines. About 115 other cases were reported by the Federal wardens, which, on account of the youthfulness of the accused, insufficient evidence, adequate fines having been imposed previously in State court, or for various other reasons, were not forwarded for Federal prosecution. The evidence in many of the cases, however, was transmitted to State game authorities for appropriate action, as violations of State laws were involved.

Convictions in Federal courts were distributed as follows: Alabama, 20; Arkansas, 15; Delaware, 13; District of Columbia, 2; Florida, 19; Georgia, 55; Idaho, 3; Illinois, 51; Indiana, 29; Iowa, 20; Kansas, 9; Kentucky, 3; Louisiana, 13; Maine, 14; Maryland, 12; Massachusetts, 13; Minnesota, 18; Mississippi, 7; Missouri, 19; Montana, 7; Nebraska, 6; Nevada, 3; New Mexico, 3; North Carolina, 4; Ohio, 14; Oklahoma, 2; Oregon, 14; Pennsylvania, 1; South Carolina, 5; South Dakota, 5; Tennessee, 14; Texas, 21; Virginia, 23; Washington, 13; West Virginia, 1; and Wisconsin, 1.

Four jail sentences, ranging from 5 months to 15 days each, were imposed against violators in Maryland and Nebraska as a result of illegal trapping, sale, and shipment of wild ducks, killing ducks in close season, and hunting ducks after sunset. While many substantial penalties were imposed, some offenders escaped with small fines and a few on payment of costs.

Fines ranging from $100 to $25 were imposed against many offenders for offering for sale and selling aigrettes, possessing ducks in storage during the close season, selling ducks, hunting ducks from motor boats, capturing live waterfowl, and operating without a Federal permit, and for other miscellaneous offenses. The fourth and fifth convictions for the hunting of wild fowl from an airplane were obtained in the Federal Court for the Eastern District of Arkansas on May 8, 1923, where the violators, charged with killing wild ducks from an airplane, were fined $20 each. Six cases involving this means of hunting are still pending.

Among other cases of interest terminated during the year may be mentioned 2 in South Carolina, involving the killing of wood ducks and resulting in a fine of $250 each; 1 in the District of Columbia,

where wild ducks were possessed in cold storage during the close season and a fine of $250 was imposed; 1 in Ohio, involving the hunting of ducks in close season, in which a fine of $125 and costs was assessed; and 1 in Missouri, involving the killing of wood ducks and resulting in a fine of $150.

### SCIENTIFIC-COLLECTING AND OTHER PERMITS.

During the year 994 permits were issued authorizing the collecting of migratory birds or their nests or eggs for scientific purposes. This is an increase of 42 permits over the previous fiscal year. About half the permits issued were limited in character, confining the operations of the permittees to the collection of nongame birds and of shorebirds during the open season for black-breasted and golden plovers and greater and lesser yellowlegs. Permits authorizing the possession, purchase, sale, and transportation for scientific purposes of migratory birds legally acquired, but not the collection of such birds, were issued to 201 persons, most of whom were taxidermists.

Permits authorizing the possession and sale of migratory waterfowl raised in captivity were issued to 3,538 persons, and permits authorizing the taking of a limited number of waterfowl or their eggs for propagating purposes were issued to 90.

The bureau issued permits authorizing the trapping of migratory birds alive for banding purposes to 847 persons, an increase over the fiscal year ended June 30, 1922, of 357. These permits are issued by the bureau in line with its investigations relative to the times and lines of flight of migratory birds. The holder of a bird-banding permit is allowed to possess a migratory bird only a sufficient length of time for it to be properly banded and liberated.

### INTERSTATE COMMERCE IN GAME.

The number of cases reported for prosecution under the Lacey Act has decreased steadily since the passage of the migratory-bird treaty act. This is due partly to the fact that the illegal interstate transportation of all wild birds now is a Federal offense under section 4 of the migratory-bird treaty act, and partly to the fact that wild animals or parts thereof are more frequently transported in interstate commerce by means other than common carrier, thus avoiding the Federal statute, although transported in violation of State laws. The bureau, through its game-warden service, has been able to render valuable cooperation in various States by unearthing shipments involving interstate commerce in birds and animals made in violation of State laws, and by collecting and reporting the evidence to State game authorities. Many States have collected thousands of dollars through fines resulting from evidence obtained by Federal wardens. Furthermore, these Federal laws have a most salutary effect in safeguarding wild life, as persons prone to violate State laws know that the valuable assistance rendered the States by United States game wardens materially lessens the chance of a violator escaping the jurisdiction of either Federal or State courts.

Evidence of approximately 200 apparent violations of State laws was turned over to State game officials during the year, and 145 State prosecutions based on information furnished by the bureau,

or in which the bureau assisted in completing the evidence, were brought to successful conclusions in State courts with fines, costs, and forfeitures totaling more than $7,000. Many guns and traps, the carcasses of 2 deer, and the skins of 27 muskrats and 66 beavers were included in the list of articles confiscated in connection with the disposition of these State cases. In an Oregon case one violator was fined $300 and sentenced to 30 days in jail.

Of six cases reported for Federal prosecution during the year, two, together with five cases previously reported, were disposed of in Federal courts. Of these seven cases, four resulted in the imposition of fines and costs totaling $250; two prosecutions were barred by the statute of limitations, because informations were not filed in time; and one was dismissed because the authorities were unable to apprehend the accused.

Many other investigations of interstate shipments were made, but did not result in prosecutions, as the shipments were either legally made or it was impossible to obtain evidence of their illegality. At the close of the fiscal year 85 cases were being investigated.

### IMPORTATION OF FOREIGN BIRDS AND MAMMALS.

The importation of foreign birds and mammals, while showing a considerable increase over that of previous years, has not yet reached the maximum prior to the World War, which was attained in the year 1913. The number of permits issued during the year was 572, an increase of 44 over the previous year, and the number of shipments inspected increased from 186 to 222. The total number of birds imported was 388,388, of which 8,331 were entered without permits.

The permits for mammal imports included 2,756 foxes from Canada, a considerable increase over the 2,064 authorized to enter in 1922. One notable importation of mammals was a shipment of 12 chinchillas, which reached Los Angeles, Calif., about February 20. This is the first consignment of which there is any record for many years of these animals actually imported into the United States.

Importation of game birds included 9,123 Mexican quail, some ruffed grouse from Canada, a few Hungarian partridges, and occasional small consignments of ducks and geese, and 600 bamboo partridges and 200 sand grouse were received from China in January. Importations of some of the rarer aviary pheasants have decreased to such a very low point that very few of some species are to be found in the United States since the dispersal of several of the larger private collections of pheasants which were brought together 20 years ago.

The principal cage birds imported as usual have been canaries and parrots, of which the canaries numbered about 182,000 and the parrots 37,721. Of the latter group, those most commonly entered are Cuban parrots, several of the other Amazons from tropical America, and grass parrakeets from Australia. A shipment of 6,000 grass parrakeets entered on June 30, 1922, passed into the hands of three of the large importers in New York, and nearly all died within six months after arrival. These were wild birds, and when cold weather came on and the windows were closed in the buildings in which they

were confined they seemed to have contracted some disease from other birds, and practically all of them were reported to have died within a few weeks. Of the popular Lady Gould finches, 816 arrived in one shipment. Of the weaver birds, 600 black-headed nuns were entered in one consignment, and about 200 in all of the rufous-necked weaver birds were brought in, about half of which arrived in one day in January.

A marked decrease in the importation of some of the common European and Asiatic birds was evident in the small number of entries of skylarks, brown linnets, chaffinches, and nightingales, as well as such of the cheaper oriental birds as Java sparrows, strawberry finches, nutmeg finches, sociable finches, diamond finches, and tricolored nuns.

A number of rare and interesting birds were included in the importations from the Old World, particularly from Africa, the Orient, and the East Indies. Among these may be mentioned two eagle owls (*Bubo bubo*), from Europe; two species of ground hornbills (*Bucorvus abyssinicus* and *B. caffer*), the red-collared wydah (*Penthetria ardens*), and the rufous-tailed wydah (*Bathilda ruficauda*), from Africa; the golden-headed mynah (*Ampeliceps coronatus*) and knobbed geese (*Cygnopsis cygnoides*), from India; 8 fire-back pheasants (*Lophura diardi*), from Siam; several species of pigeons from the East Indies and South Pacific, including 2 bronze-winged partridge pigeons (*Geophaps smithi*) from northwestern Australia, 30 *Phlogoenas rubescens* from the Marquesas Islands, 2 yellow-breasted fruit pigeons (*Leucotreron occipitalis*) from the Philippines, one nutmeg pigeon (*Myristicivora bicolor*) from the East Indies, and 12 bleeding-heart doves (*Phlogoenas luzonica*) from the Philippine Islands. The Marquesas Islands pigeons apparently represented the first importation of this species into the United States, and the bleeding-heart doves were the first that had been received from the Philippines for some time, although before the war considerable numbers of these interesting birds were entered at Pacific coast ports.

An attempt has been made to coordinate efforts by zoological gardens and museums to obtain some of the rarer birds. Several years ago an anomalous condition existed under which certain birds which were entirely unrepresented, or very poorly represented, in some of the largest public museums in this country were exhibited alive in several zoological gardens, while the museums failed to realize for some time the opportunity of obtaining desirable material in case the birds died. Two notable examples are those of the golden-headed mynah of India (*Ampeliceps coronatus*) and a handsome African weaver bird (*Hyphantornis cucullatus*), which until recently were represented in the United States National Museum by one or two specimens, and yet 18 of the mynahs and more than 200 of the weaver birds were imported alive during the year. This condition has been partially remedied by checking up the lists of desiderata of some of the larger museums, so that it is now possible to tell whether or not imported birds are represented in museum collections as well as in zoological gardens.

Many inquiries are received from time to time in regard to the importation of foreign game birds which may be useful for stocking covers or increasing the local game supply. Unfortunately, it can not be said that importations of game birds since the war have done

very much for the improvement of existing conditions. Mexican quail, which have been imported in considerable numbers, have been distributed for the most part in only four or five States, and the rest of the country has received little benefit from these importations. A few ruffed grouse have been imported from Alberta, but in such small numbers as to provide breeding stock for only a few localities. Pheasants have been conspicuous by their absence, but this may indicate that the main demand for ring-neck pheasants is now supplied by stock bred in this country. A few Hungarian partridges have been brought in, but high prices at present prohibit restocking with these birds on a large scale.

The demand for new birds can not be met properly until there is closer cooperation between aviculturists, experimenters, and game commissions in order to ascertain the precise conditions under which certain species may be acclimated and the peculiar treatment required by each. Among the more promising game birds are the Prince of Wales and true Mongolian pheasants, tinamous of several species from South America, the chuckar partridge from India, the bamboo partridge from China, the red-legged partridge, and the black cock of Europe. Spasmodic attempts have been made from time to time to introduce these birds into the United States, but sustained experiments under favorable conditions have not been continued long enough to ascertain the reason for lack of success.

### IMPORTATION OF QUAIL FROM MEXICO.

Comparatively few quail were imported from Mexico during the past spring, notwithstanding the extensive preparations made by several importers. The first shipment of 72 birds was entered at Brownsville, Tex., on January 3, but, by common consent, dealers postponed operations until February so that the birds would not arrive in the north during cold weather. Shipments did not begin regularly until February 15, but during the next month they arrived at frequent intervals at the ports of Brownsville and Laredo, Tex. No birds were entered at Eagle Pass, Tex.

Owing to restrictions imposed by Mexican authorities comparatively few large shipments were brought in, most of the birds being entered in consignments of 500 or less. About 6,500 were forwarded to the Kentucky game and fish commission, some were shipped to the conservation commission of Maryland, and others were distributed to various other States. No quail disease appeared, and shipments were admitted to entry without being held in quarantine, but were examined as usual by inspectors of the Bureau of Animal Industry. Importations reached their maximum early in March, but fell off noticeably toward the latter part of the month.

The total number of quail imported during the season was 9,123, which makes the total number of Mexican quail entered during the 13 years since importations began 161,471.

## PUBLICATIONS ISSUED FROM THE BUREAU DURING THE YEAR.

### NORTH AMERICAN FAUNA.

No.

46. A Biological Survey of the Pribilof Islands, Alaska: Part I, Birds and Mammals; Part II, Insects, Arachnids, and Chilopods. Pp. 255, pls. 15 (including 3 maps).

DEPARTMENT BULLETINS.

No.
1078. Beaver Habits, Beaver Control, and Possibilities in Beaver Farming. Pp. 31, pls. 7, figs. 7 (including map).
1089. Reindeer in Alaska. Pp. 74, pls. 24, figs. 2 (including map).
1091. Life History of the Kangaroo Rat, *Dipodomys spectabilis spectabilis* Merriam. Pp. 40, pls. 9, figs. 3 (including map).
1145. Migration Records from Birds Banded at Great Salt Lake, Utah. Pp. 16, pls. 2, fig. 1 (map).
1151. Silver Fox Farming. Pp. 60, pls. 4, figs. 46 (including map).

FARMERS' BULLETINS.

1288. Game Laws for 1922. Pp. 80.
1293. Laws Relating to Fur Animals, 1922. Pp. 30.
1302. How to Get Rid of Rats. Pp. 14, figs. 8.
1327. Canaries: Their Care and Management. Pp. 22, figs. 6.

REVISED EDITIONS.

506. Food of some Well-known Birds of Forest, Farm, and Garden. Pp. 34, figs. 16.
587. Economic Value of North American Skunks. Pp. 24, figs. 10.
621. How to Attract Birds in the Northeastern States. Pp. 16, figs. 11.
702. Cottontail Rabbits in Relation to Trees and Farm Crops. Pp. 14, figs. 4.
844. How to Attract Birds in the Middle Atlantic States. Pp. 16, figs. 11.
869. The Muskrat as a Fur Bearer, with Notes on Its Use as Food. Pp. 20, figs. 4.
1239. Community Bird Refuges. Pp. 16, figs. 3.
1247. American Moles as Agricultural Pests and as Fur Producers. Pp. 24, figs. 16.

DEPARTMENT CIRCULARS.

242. Directory of Officials and Organizations Concerned with the Protection of Birds and Game, 1922. Pp. 20.
260. Report of the Governor of Alaska on the Alaska Game Law, 1922. Pp. 7.
261. Bird Censuses and How to Take Them. Pp. 4.

SERVICE AND REGULATORY ANNOUNCEMENTS (BIOLOGICAL SURVEY).

47. Hunting of Wild Fowl on Salt River Reservation, Ariz. P. 1.
48. Migratory Bird Treaty Act and Regulations. (Including amendments of March 8, 1922.) Pp. 12.
49. Importation of Quail from Northeastern Mexico. P. 1.
50. Trapping of Fur-bearing Animals on Big Lake Reservation, in the State of Arkansas. P. 1.
51. Regulations for the Protection of Land Fur-bearing Animals in Alaska. P. 1.
52. Regulations for the Protection of Land Fur-bearing Animals in Alaska. P. 1.
53. Regulations for the Protection of Game in Certain Localities in Alaska. Pp. 3.
54. Regulations for the Importation of Eggs of Game Birds for Propagation. Pp. 2.

PUBLICATIONS IN PRESS AT CLOSE OF YEAR, WITH MANUSCRIPT TITLES.

Report on Bird Censuses in the United States, 1916 to 1920. (Department Bulletin No. 1165, pp. 36, fig. 1, map.)
Food and Economic Relations of North American Grebes. (Department Bulletin No. 1196.)
Local Names of Migratory Game Birds. (Miscellaneous Circular No. 13, pp. 95, figs. 52.)
Migratory Bird Treaty, Act, and Regulations. (Including amendments of June 11, 1923.) (Service and Regulatory Announcements—B. S. 55, pp. 13.)
Bird Houses and How to Build Them. (Revision of Farmers' Bulletin No. 609.)
Some Common Birds Useful to the Farmer. (Revision of Farmers' Bulletin No. 630.)
Common Birds of Southeastern United States in Relation to Agriculture. (Revision of Farmers' Bulletin No. 755.)

# REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PUBLIC ROADS,
*Washington, D. C., October 15, 1923.*

SIR: I have the honor to submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1923, covering especially those functions of the Bureau which are provided for by the act making appropriations for the Department of Agriculture. A full statement of work in connection with the construction of Federal-aid and national forest roads will be made in a subsequent report as provided for in section 19 of the Federal highway act, approved November 9, 1921.

Respectfully,

THOS. H. MACDONALD,
*Chief of Bureau.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## INTRODUCTION.

The functions of the Bureau of Public Roads divide themselves according to their nature and the legislative authority for their performance into two general classes, comprising: (1) The administration of Federal-aid and forest road construction under the Federal aid road act of July 11, 1916, and its amendments, and (2) the work of an educational and scientific nature with respect to road management, finance, construction, and maintenance, and agricultural engineering subjects involving land drainage and irrigation, farm water supplies and waste disposal, farm power, farm architecture, and other matters relating to the application of engineering principles to farm life.

The first class of functions, those relating to the Federal aid and forest road work, are largely of an administrative nature, involving cooperation with the State highway departments in the preparation of plans, specifications, and estimates for Federal-aid roads, the inspection of projects necessary for the control of construction in accordance with the provisions of Federal legislation, and supervision of the construction of forest highways.

The Federal highway act, approved November 9, 1921, requires that the Secretary of Agriculture shall make a report to Congress on or before the first Monday in December of each year, in which he shall include a detailed statement of the work done, the status of each project undertaken, the allocation of appropriations, an itemized statement of expenditures and receipts during the preceding

fiscal year, and other information specifically defined in the act necessary for a full and comprehensive report of the activities under the act during the preceding fiscal year. As all such information will be set forth in complete detail in that report, there is indicated in this report only a summary of the salient facts with reference to the expenditure of Federal and State funds, the mileage of roads completed during the fiscal year, and the aggregate of mileage completed since the initiation of the work by the Federal-aid road act, approved July 11, 1916, together with a statement of the work under construction at the close of the fiscal year.

The second class of functions, those provided for by the act making appropriations for the Department of Agriculture, involving scientific research with respect to roads and agricultural engineering, are covered in full in this report.

## FEDERAL AID ROAD WORK.

Eight thousand eight hundred and twenty miles of roads of all types were completed during the fiscal year, which, added to the mileage completed prior to the fiscal year, brought the total of completed projects up to 26,536 miles. The mileage completed during the year is classified as follows:

| | Miles. |
|---|---|
| Graded and drained | 1,860.1 |
| Sand-clay | 749.5 |
| Gravel | 3,815.4 |
| Water-bound macadam | 335.6 |
| Bituminous macadam | 452.9 |
| Bituminous concrete | 76.8 |
| Concrete | 1,440.3 |
| Brick | 78.8 |
| Bridges | 10.8 |
| Total | 8,820.2 |

The projects under construction at the close of the year amounted to 14,772 miles and were estimated as 53 per cent complete. In addition to the 26,536 miles completed and the 14,772 miles under construction, there were at the close of the year a number of projects approved but not yet placed under construction, the aggregate length of which was 6,917 miles.

The total cost of the roads completed during the year was $148,152,528, of which $63,087,079 was paid by the Federal Government.

## DESIGNATION OF THE FEDERAL-AID HIGHWAY SYSTEM.

The work of selecting the roads to constitute the Federal-aid highway system, begun during the preceding fiscal year, was continued with all possible expedition consistent with the far-reaching importance of the decisions involved. By the close of the year tentative systems had been submitted by the State highway departments or proposed by the Bureau of Public Roads for all States.

As the result of conferences with officials of the several States and groups of States, 35 of these systems had been definitely approved by the Secretary at the close of the fiscal year, and it was anticipated that the systems of the remaining States would be approved by the fall of 1923.

The total mileage of highways existing in the United States at the time of the passage of the Federal highway act (Nov. 9, 1921),

as certified by the State highway departments, was 2,859,575 miles. The maximum mileage that can be included in the system for the whole country, being 7 per cent of the total mileage, is 200,170 miles. The mileage included in the 35 systems approved up to the end of the fiscal year was 111,699 miles; and as the permissible 7 per cent of existing mileage is, in general, not being included in the system as initially approved, it is not likely that the initial program will include more than 180,000 miles.

Analysis of the approved systems for the 35 States shows that of the 1,111 cities of 5,000 or more population in these States, 1,048 of them lie directly on the approved system, and there is probably not one but will be connected with the system by an improved State or county road. When the system is completed, therefore, one will be able to travel from any town of 5,000 population or greater to any other town of the same size without leaving an improved road.

The detailed study of the availability of the roads to the total population indicates that for the country as a whole it is safe to say that fully 90 per cent of the total population resides not more than 10 miles from the roads included in the system. In individual States the percentage runs almost to 100 per cent; for example, Maryland, in which fully 97½ per cent of the people live within a 10-mile zone on each side of the roads, and Indiana, in which less than 1 per cent lives farther than 10 miles from the roads.

A road of the approved system will cross the western mountains at practically every one of the important passes. The Rockies will be crossed at Berthoud, Lookout, Gibson, Targhee, Pleasant Valley, and Reynolds Passes in Montana and Idaho; La Veta, Wolf Creek, and Red Mountain Passes in Colorado and Raton Pass on the Colorado-New Mexico line. The Cascade Range will be crossed at Stephens and Snoqualmie Passes in Washington and Grants Pass in Oregon, and the Sierra Nevadas will be crossed at Truckee and Walker Passes in California. These passes are the controlling points on the transcontinental routes westward. They are the passages through which the national roads must cross the mountain barriers. Leading to them from the east and west the roads of the Federal-aid highway system will form a perfect network of interconnected highways branching into every section of the country.

In designing the routes to be included in the Federal-aid system, the chief aim of the States and the Federal agency has been to select routes which will give the maximum of local service and connect with one another to form a great national system of highways.

## ROAD CONSTRUCTION IN THE NATIONAL FORESTS.

The Federal highway act carried an appropriation of $10,000,000, available for the fiscal year 1923, for the survey, construction, reconstruction, and maintenance of forest roads and trails. The act provided that 50 per cent of the appropriation for any fiscal year, but not exceeding $3,000,000, for any one fiscal year should be expended on roads and trails necessary for the protection, administration, and utilization of the forests. The balance of the appropriations is to be expended under the terms of the law for the improve-

ment of roads of primary importance to the States, counties, or communities within, adjoining, or adjacent to the national forests.

The latter provision is a necessary adjunct to the program of the Federal-aid highway system. On account of the large areas of forest lands in some of the Western States, the development of a system of main highways that will properly serve the State and local communities requires that the forest highways and the roads of the Federal-aid system be combined into one system.

The procedure laid down by the Secretary for the selection of the forest highways to be improved as a part of this plan calls for the preparation of a program map for each State, showing the roads agreed upon by the State and local authorities and recommended by the forester and the Chief of the Bureau of Public Roads. There are 28 States, excluding Alaska, in which there are forest areas, and these maps had been prepared and definitely approved by the Secretary for 9 States up to the close of the fiscal year. Several more had progressed almost to the point of approval. These maps, when approved, constitute the general program for highway construction in the forest areas, and their preparation is receiving the careful consideration their importance merits. Pending the approval of all the maps, a program for surveys and construction for the fiscal year 1923 was set up by the forester and the Chief of the Bureau of Public Roads. Only projects which, with reasonable certainty, will be included in the general combined system of Federal-aid highways have been included in this program.

During the year 197.4 miles of forest road were completed at a cost, exclusive of the cost of the survey and plans, of $1,737,055.50. The total mileage completed up to the end of the year was 1,536.7 miles, and the cost of this mileage was $13,769,212.16.

At the close of the year 932.5 miles of road were under construction and $4,635,032.13 had been disbursed to date. Surveys were in progress for 1,014 miles in 62 projects and $270,139.51 had been disbursed to date on this work. The completed surveys, involving 3,207 miles in 237 projects, had cost $767,914.59. These survey costs do not include an item of $16,224.75 which was spent by the Bureau of Public Roads in perfecting plans made by other agencies and used by the bureau.

## INVESTIGATIONS IN HIGHWAY ECONOMICS.

During the past decade the growth of the American highway system has increased rapidly, stimulated by the realization of the economic and social values arising from the development of highways, the increased economic utility of the motor vehicle, and by the rapid yearly increase in motor-vehicle ownership. The result of this growth is the reemergence of the highway as a factor in the transportation of people and goods.

The history of the modern highway is so brief and its growth has been so rapid that there is an amazingly meager body of authentic evidence from which we can measure its economic value or determine its economic sphere of operation as a correlated part of our transportation system.

The literature of the past few years dealing with highway transportation, particularly the transportation of freight, contains a

variety of conflicting predictions and conclusions, usually based upon fragmentary or localized data, rather than facts.

The problems of an economic nature created by the development of highway transportation, as to its proper relation to rail transportation, the justifiable expenditure of public funds for the provision and maintenance of the roads, the apportionment of the burden of taxation, the regulation of the use of the roads, these problems, to name only a few, can never be properly solved by theorizing. They are so fundamental, and the interests affected are so varied and conflicting, that impartial and scientific information is the only safe basis for a rational and satisfactory answer.

A sufficient volume of highway transportation data in typical sections of the country must be produced in the near future to provide an authentic basis for analysis, discussion, and an intelligent formation and appraisal of policies to govern the highway transportation of freight and passengers, as well as data necessary to the formation of policies governing the construction and maintenance of highway systems.

With the conviction that a large volume of highway transportation facts is a prerequisite to the solution of many of the problems of highway construction, maintenance, and transportation, and uninfluenced by prior beliefs or prejudices, relying on the evidence secured to indicate the answers, the bureau, in cooperation with the Connecticut State Highway Commission, inaugurated, in September, 1922, a one-year survey of highway transportation over the Connecticut highway system.

It is hoped that this survey and similar investigations to follow will produce data which will serve the following purposes:

1. Serve as an aid in allocating construction and maintenance funds according to the distribution of traffic over the highways.
2. Enable the prediction of future traffic.
3. Determine the daily and seasonal traffic density of passenger cars and motor trucks on primary and secondary highways.
4. Determine the range of gross loads, net commodity loads, and the prevalence, amount, and character of overloading.
5. Determine seasonal variations in movement of commodities.
6. Determine the average clearance width of trucks of various capacities, and the relation of the width of the truck to truck overloading.
7. Determine the character of commodities shipped by highway, and the nature of the shipment, whether by regular trucking companies, by contracting truck operators, or by privately operated trucks.
8. Determine the length of haul for motor trucks of various capacities and the influence of commodities and character of producing areas on the length of haul.
9. Determine the relation of motor transport by highway to other methods of transportation, as to rates, freight, classification, schedules of operation, delivery time, net tonnage, and length of haul.
10. Determine the number of passengers transported by highway and the percentage of business and nonbusiness use of motor cars.

## IMPORTANT OBSERVATIONS FROM THE CONNECTICUT TRANSPORTATION SURVEY.

Observations during the first three months of the survey have brought to light information of direct practical value, which the records of the balance of the year will undoubtedly amplify.

While it is indicated that a total of 1,019,688 net tons of commodities were transported over the Connecticut highway system during the three-months period beginning in September, 1922, the competition of the highway with the railway is not by any means as serious as this large movement would indicate. More than a third of this tonnage was moved only from 1 to 9 miles, and was distinctly a local noncompetitive distribution of goods; 30½ per cent, nearly another third, was moved from 10 to 29 miles. In this, which may be called the short-haul zone, the tonnage transported was found to be largely noncompetitive. One portion is the local distribution from jobbers and wholesalers to retailers; another portion is shipped from points without rail facilities and by its nature can not be competitive. The balance of the total net tonnage, approximately 33 per cent, was transported 30 miles or more. This movement was found to be partially competitive. It is, however, a transportation of goods which is not determined by the rate charged for the transportation, but rather by the lack of efficient rail service, the character of the commodities, and the element of time of delivery.

A mass of data has been developed relating to all the purposes of the investigation as set forth above, which serves to indicate with greater clearness than has heretofore been possible the economic field of motor-truck transportation. These data, however, as previously stated, are only the first results of an investigation which to be conclusive must be carried much further under not one condition, but a number of conditions typical of the varied production and economic status of the sections of the United States.

A preliminary report on the first three months of this investigation will be published shortly, to be followed by a complete report as promptly as the observations for the entire one-year period can be digested.

## STUDY METHODS OF HIGHWAY FINANCE.

The slender factual basis for discussion and action in respect to highway transportation has its counterpart in the field of highway finance. There are wide differences in method and distribution of the cost of highway improvement between the sources of highway revenue. Neighboring States follow entirely different systems of financing. The lack of uniformity is due largely to a lack of evidence upon which to build a national system. During the past few years a distinct opposition to the growth of the highway bill has developed. But, in the judgment of well-informed students of the situation, the current criticism of the large sums raised for the improvement of the public highways is a criticism of the inequalities and unfairness of the present methods of financing rather than a criticism of the amount of highway funds expended yearly. Though the criticism frequently takes the form of opposition to bond issues, the real cause of the resentment that undoubtedly exists in some quarters is the feeling that the distribution of the cost to property owners and motor-vehicle operators has not been equitably adjusted.

Believing that the formulation of sounder and more equitable methods must rest upon a more specific knowledge of the facts, the bureau has undertaken to make a thorough study of the sources of highway revenue, local, county, and State. Most of the previous investigations have been limited to a study of the sources of State revenue, disregarding the county and local expenditures, which, in the light of the recent investigation, has been found to be a serious omission. The money for the construction and maintenance of roads, whether they be local or county or State roads, eventually is drawn from the same groups, and a financial policy which fails to consider the system of taxation as a whole is almost certain to lead to burdensome and inequitable conditions.

Wisconsin was selected as the place of the study as being a State whose system of highway financing represents a fair average of the methods employed in other States. Four counties—Dane, Outagamie, Rusk, and Waukesha—were selected as typical counties representative of the highway development in different sections of the State.

Among the significant findings of the investigation, many of which are at variance with opinions widely held, are the following:

1. The major portion of the total highway funds are raised by township and county units rather than by the State.

2. Real property taxation is the chief source of highway revenue derived from these counties, producing an average of 62 per cent of all the money expended.

3. Vehicle license fees produce 9 per cent of the total funds raised in the counties.

4. The major portion of the burden on real property in the counties is due to local and county taxation. The local and county units receive 89.3 per cent and the State only 10.7 per cent of the real property revenue.

5. Real property contributes a larger share of highway revenue during periods of depression, when other revenues decrease.

6. As a county develops and grows richer the relative burden on real property for highway purposes decreases. When a county is in the developmental stage the cost of the permanent features of highway improvements can be deferred by issuing a reasonable amount of highway bonds.

7. A reduction or elimination of State taxation of real property will not materially reduce the total of real property taxes for highway purposes.

8. Significant reduction of real property taxation can only be made by reduction of county and local taxes.

## MOTOR-TRUCK TRANSPORTATION IN NEW ENGLAND.

There is a wide difference of opinion as to the degree to which motor-truck transportation competes with and is likely to be embarrassing to the railroads. In some isolated instances it is clear that the truck has become a dangerous competitor, and these instances are cited by railroad interests as indicative of a general tendency. With the object of ascertaining the extent of such competition in New England, and also to supplement the information obtained in the Connecticut transportation survey as to the organization, operation, and rates of motor-truck companies, and also to

determine to what degree the motor truck is offering a service correlated to that of the railroads, a study has been under way during the past year in Massachusetts and Rhode Island.

The bureau representatives have gone directly to the principal manufacturers and motor-trucking companies in these States with questions as to the reasons why commodities are shipped by motor truck, the portion of the business that is handled by motor trucks, railroads, and ship lines, respectively, the extent to which correlated service involving two or more agencies has developed, and the rates charged for service.

The investigation was still in progress at the close of the fiscal year, so that it is not possible at this date to report any conclusions. However, it may be said that the study gives promise of developing interesting information with respect to a recent transportation development involving motor trucks and railroads and ship lines offering combined service.

## THE INFLUENCE OF HIGHWAY IMPROVEMENT ON RURAL LAND VALUES.

The influence of road improvement on land values is an economic question with regard to which there has been a great amount of speculation. Much of the information on which opinion is based is, however, far from scientific and possibly inaccurate. The bureau has engaged within the past year in an effort to obtain, for one set of conditions, at least, an array of information scientifically gathered, which will suggest the real influence of various type of highway improvement on land values under different conditions as to crops, population, soil characteristics, and other factors affecting the value of rural land.

The increase in land value obviously has an important bearing on the taxation of land for highway purposes. To determine this effect of road improvement, the bureau's studies include improvements of all types from dirt to concrete, and it is anticipated that a report that will contain valuable basic data will be ready soon.

## PHYSICAL RESEARCHES AND TESTS.

Researches in the physical field designed to supply scientific data for use in road design have become one of the most important and useful activities of the bureau. The various tests and investigations are followed closely by highway engineers the country over, and an encouraging indorsement of their value is found in the increasing attention they are attracting in foreign countries.

The investigations which have attracted the greatest amount of attention are the tests of the effect of impact on road slabs and the tests of bituminous pavements of various composition to determine their relative stability under traffic. The phenomenon that is being observed in the latter investigation is the formation of the familiar "washboard" wrinkles which appear in the surface of bituminous roads under traffic.

For the impact experiments a series of 120 special road slabs were constructed during the preceding fiscal year. These are now being tested. Two large, portable impact machines, designed to deliver to the slabs blows such as are delivered to actual road slabs by motor-truck wheels have been put into operation. Up to the present time

only 12 of the slabs have been tested, but the work is proceeding as rapidly as possible.

In this connection it is pertinent to observe that in many of its physical researches the bureau is dealing with forces and phenomena which have not heretofore been measured or defined. It is not unusual to find that there is no measuring instrument in existence capable of use to secure the necessary scientific data. Under such circumstances it is necessary to halt the investigation until suitable instruments can be devised. The development of measuring instruments occupies much of the time of the investigators, and, although the progress of the research is retarded, the scientific apparatus contributed by the bureau in this way is in itself exceedingly valuable.

In connection with the impact tests several important pieces of apparatus have been designed, among them a strain gauge for measuring and recording graphically the instaneous deformation which takes place in a road slab when it is subjected to impact. This apparatus, which is so designed that it can be placed anywhere in a pavement slab, makes it possible to determine the amount and distribution of the stress in the slab when it is subjected to the impact of a loaded truck or other moving vehicle. A special accelerometer, the purpose of which is to determine the force of impact by measurement of the deceleration of the truck wheel on contact with the road surface, has also been constructed.

The tests of each of the concrete slabs subjected to impact include the application of impact forces the values of which are determined by means of the accelerometer, and the determination of the effect of the impact on the slab by means of the specially designed graphic strain gauge, which records the instantaneous deformation, and another instrument which records the instantaneous deflection.

The results of the tests so far are not sufficient in number to permit any final conclusions to be drawn as to the relative strength of the slabs, but the instruments have been proved to be sufficiently accurate and sensitive to develop the data from which such conclusions can be drawn.

The investigation of the relative stability of bituminous pavements was practically completed during the fiscal year, so far as the actual tests are concerned. Considerable study and additional work will be required, however, to locate definitely the factors which cause or prevent the characteristic shoving of the surface.

For the purpose of the experiment a number of sections of bituminous concrete pavement were constructed in the form of a circular track approximately 600 feet in circumference and 13 feet wide.

The object of the test was to study the effect of variations in the size of aggregates, percentage of asphalt, and hardness of asphalt on the resistance of the bituminous concrete to shoving under motor-truck traffic. By the end of the fiscal year approximately 40,000 trips of a 3-ton loaded motor truck, operating at a speed of 10 to 12 miles per hour, had been made. The experimental results were very pronounced. Shoving and displacement of the surface in the direction of the traffic was marked in a number of sections. As stated above, the actual testing has been practically completed.

The study of the relative wear of the 62 sections of experimental concrete pavement constructed last year and subjected to an

accelerated wear test was continued. By the end of the fiscal year the specially designed machine equipped with four wheels, carrying solid rubber tires, had made approximately 50,000 trips. The machine has been operated at a speed of 22 miles an hour, each wheel being loaded with 600 pounds per inch of tire. The results of the experiment to date are not such as to warrant drawing definite conclusions other than the statement that actual surface wear under rubber-tired traffic without impact is exceedingly slow.

### NONBITUMINOUS ROAD MATERIALS RESEARCH.

In addition to the major researches previously described the following investigations of the properties and uses of nonbituminous highway materials have been under way during the year. Studies regarding the effect of alkali on the strength of concrete, mentioned in last year's report, have been continued with special reference to methods of retarding or neutralizing the destructive action of the alkali salts. Interesting and encouraging results have been obtained in connection with the use of water-gas tar and paraffin as protective agents. The study of the effect of organic impurities on the strength of concrete to which attention was called in last year's report was also continued, special attention being given to practical methods of neutralizing such harmful ingredients. Several methods which have been proposed from time to time for curing concrete pavements without the use of water were studied.

The investigations relative to the suitability of blast-furnace slags as concrete aggregate have been finished. Results of the investigation, which are reported in a paper presented before the American Society for Testing Materials, indicate that slag is suitable for such use and that the strength of slag concrete is equal to the strength of concrete in which other acceptable aggregates are used.

A bulletin giving cost data on the production of broken stone as obtained in the field from 23 quarries was completed. Various types of quarries and crushing plants were included in the study, such as pit, open-face, high and low face, as well as large and small plants. Quarries were selected so that data might be obtained according to various kinds of rock. A unit system of recording costs was adopted and it is believed that the results will be of service to all engineers engaged in rock excavation.

Laboratory studies in cooperation with the committee on tests of the American Association of State Highway Officials and various technical committees of the American Society for Testing Materials were conducted with special reference to such problems as the standardization of strength tests for fine aggregate used in concrete, compression tests of rock, and abrasion tests of crushed rock. Studies involving the scientific proportioning of concrete by the sieve methods which have been proposed were likewise carried on during the year.

### BITUMINOUS ROAD MATERIAL RESEARCH.

In addition to the bituminous stability investigations, the following bituminous material researches were conducted during the year. The study of samples of asphaltic pavements taken from a number of large cities, which was begun last year in cooperation with the Asphalt Association and the street departments of the cities involved, was continued during the fiscal year. The testing of the samples

has been practically completed. Considerable work, however, remains in connection with the final analysis and correlation of results.

Tests of the toughness and adhesiveness of bituminous materials and mixtures were carried on in cooperation with the committee on tests of the American Association of State Highway Officials, and a progress report was made at the last meeting of the committee.

Work in connection with the standardization of the tests of materials in cooperation with the American Association of State Highway Officials and the American Society for Testing Materials was conducted with special reference to the float test for the consistency of tar products and the penetration test for asphalt cements.

### AUTOGRAPHIC TRAFFIC COUNTER DEVELOPED.

One of the instruments devised during the year is an autographic traffic counter which, when installed in a road, will record the number and weight of all vehicles passing the point of installation. It is a fundamental principle of economic highway improvement that the roads built should be adequate for the traffic they are expected to carry, and a corollary of this principle is that no road should be improved to a degree in excess of the requirements of the traffic. A precise knowledge of the volume of traffic and the weight of the vehicular units is essential to the practical application of these principles, and the new instrument developed by the bureau gives promise of usefulness in securing this information with a minimum expenditure of effort and money.

### COOPERATIVE RESEARCHES.

In addition to the researches conducted solely by the bureau, a number of investigations have been carried on in cooperation with several of the State highway departments, universities, and experiment stations. These investigations, which involve studies of highway design, materials, and economics, include the following:

#### With the Engineering Experiment Station of Purdue University.

Experiments have been conducted to develop a ball test for mortar and concrete. The load required to press a steel ball into the surface of a material has been found to be a good index of the general strength and qualities of some materials. In the form of the Brinell test it is used for steel, and it also applies to wood. The purpose of this cooperative research was to determine the applicability of a similar test to concrete, and the results indicate not only that such a test can be applied to determine the surface strength of concrete and mortar, but that it may throw valuable light on the question of fatigue of such materials under repeated applications of load.

Other experiments in connection with the fatigue of mortar and concrete and stresses in road slabs, as affected by moisture content, have also been conducted in connection with this university. The significance of these experiments in connection with the design of concrete road surfaces which are subjected to frequent repetitions of concentrated loads, and which are exposed to moisture from all sides, will be readily apparent. Observation of concrete pavements under actual service conditions has suggested the possibility that there may be a gradual depreciation in their strength as the result of repeated deformation under load and the tests thus far made

serve to confirm this observation, the indications being that beams subjected to repeated applications of load will fail under loads considerably less than would be required to produce failure with a single application.

WITH THE UNIVERSITY OF GEORGIA AND GEORGIA STATE HIGHWAY DEPARTMENT.

An investigation of the effective life of sand-clay, topsoil, and similar roads in the State system of Georgia is in progress. In view of the extensive use of these types of road surface in those States whose road systems are in the stage of development, it is very desirable that definite information in regard to their life be available in order that their comparative economy with respect to other types of higher initial cost and longer life may be determined.

WITH THE ENGINEERING EXPERIMENT STATION, IOWA STATE COLLEGE.

An important investigation of the resistance of various kinds of road surface to traction of motor vehicles, which is being conducted by this experiment station with our cooperation, has already produced information of the greatest value. It is indicated that the saving in gasoline consumption resulting from the paving of an earth road is sufficient on the heavily traveled trunk highways to pay the entire cost of surfacing in a remarkably short time.

With the same experiment station investigations are also under way to determine the effect of impact on highway bridges and also to determine the load transmitted to highway culverts through various depths of fill and the effect of impact delivered through such fills. In the investigation of the effect of impact on bridges a new photographic strain gauge, designed by the bureau, is being used to measure the instantaneous deformations which are caused by the impact of vehicles. The instrument is so designed that inertia of moving parts is reduced to a minimum. It responds quickly and indicates the stress under very high impact conditions.

WITH THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

An important research on the tractive resistance of roads has been conducted in cooperation with this institution and the Quartermasters Department, United States Army. It is closely related to the tractive-resistance investigations at Iowa State College.

Other cooperative investigations which have been under way during the fiscal year are listed as follows:

With the engineering experiment station, University of Texas:
1. Study of wear-resisting properties of concrete aggregate.
2. Effect of moisture on volume change in soils.

With New Hampshire State Highway Department:
Study of sands of New Hampshire for use in concrete.

With the University of Maryland and Maryland State Roads Commission:
Effect of traffic and climatic changes on the character of concrete.

With the engineering experiment station, Kansas State Agricultural College:
Investigation of wind resistance to motor vehicles.

With the North Carolina State Highway Commission:
Sand-clay and topsoil road investigations.

With the American Association of State Highway Officials, committee on tests, and the New York State Highway Commission:
Causes of disintegration of concrete roads in New York State.

With the National Academy of Sciences, advisory board on highway research of the National Research Council:
1. Census of highway-research projects in the United States.
2. Formulation of a national program of highway research.

No record of the year's work would be complete which did not make special mention of two cooperative projects that have attracted world-wide attention. The bureau cooperated with the Illinois Department of Public Works and Buildings in securing the experimental data at the Bates experimental road, near Springfield, Ill. For the construction of the 2-mile section of experimental roadway and the enterprise and vision which made the road possible entire credit is due to the State authorities, but the bureau rendered assistance by assigning engineers and apparatus and cooperated with the State officials in the study of the experimental data.

The other notable cooperative experiment is that which has recently been completed at Pittsburg, Calif. This project was initiated by the Columbia Steel Co. in the spring of 1921. From the beginning it has been under the observation of engineers officially assigned by the bureau and the California Highway Commission, and a number of the designs for concrete road sections had been made by the two public agencies. When it became apparent that the project needed assistance in securing the necessary trucks to accelerate the test, the bureau and the State commission supplied the need. Finally, in 1922, when the test indicated results of considerable usefulness to all road-building design, formal financial cooperation of the California Highway Commission and the bureau was arranged to complete the test and publish the results. The report of the test, recently published, is generally considered to be one of the outstanding contributions to highway engineering knowledge.

In both the Pittsburg and Bates road tests the project consisted of the testing of various types and designs of pavement under actual truck traffic. While the results obtained were more or less dependent upon the local subgrade conditions, they are applicable directly to all similar conditions in the United States, and with suitable modifications everywhere.

The policy of taking part in these cooperative projects furnishes the means of securing the services of the foremost investigators in particular fields, as well as personnel and the use of equipment not available in Washington. To a considerable extent it has the effect of coordinating the efforts of the various organizations into a concerted attack on urgent highway problems.

### ROUTINE TESTING OF HIGHWAY MATERIALS.

In addition to the research work, the bureau has continued to make routine laboratory examinations of various materials used in road construction. During the fiscal year 1,686 samples of road material were examined in the laboratories—1,038 in the physical laboratory and 648 in the chemical laboratory; 1,000 of these samples were of materials intended for use on specific Federal-aid projects; the remainder were miscellaneous materials submitted by individuals or corporations for the purpose of determining their general suitability in road construction.

One thousand and nine samples of nonbituminous materials were examined and classified in the petrographic laboratory, including 335 samples of rock, 177 of gravel, 310 of sand, and the balance miscellaneous materials.

Cooperation with various State, university, and commercial laboratories engaged in the examination of materials for Federal-aid roads has also been continued. This is done to secure and maintain

uniform methods of testing throughout the country. With this purpose in view representatives of the bureau, during the year, visited 32 of the 68 laboratories engaged in this work and conferred in each case with the engineer in charge of the laboratory relative to methods of testing and material control.

As a further means of control over methods employed in testing road materials, a system of check testing was inaugurated at the beginning of the past fiscal year, whereby duplicate samples of materials were to be submitted to the bureau and to the State or other laboratory engaged in the routine testing. One hundred and eighty such check tests were made during the year.

At the beginning of the fiscal year the bureau's division of tests discontinued all routine supervision over material control on Federal-aid work other than as outlined above. This supervision was concentrated in the various district offices under the immediate jurisdiction in each case of a materials engineer designated by the district engineer for the purpose. In order to train the materials engineers in the details of the work which they were to perform, they were called to the Washington office in February and given a course in materials testing, the results of which have been reflected in the increased attention given material matters in connection with the construction of Federal-aid roads.

## FARM DRAINAGE INVESTIGATIONS.

One of the outstanding drainage investigations conducted during the fiscal year 1923 was that relating to the flow of water through pipe culverts at the hydraulic laboratory of the State University of Iowa, at Iowa City, where exceptional facilities are available for such work. During the year vitrified clay, corrugated metal, and concrete pipe culverts 30 feet long with diameters of 12, 18, 24, and 30 inches were tested, the work being done in cooperation with the State University of Iowa. The coefficient of roughness $n$ in the Kutter formula, for concrete pipe ranges from 0.012 for the 12-inch size to 0.013 for the 30-inch size, for vitrified clay pipe from 0.010 for the 12-inch size to 0.013 for the 30-inch size, and for corrugated metal pipe from 0.019 for the 12-inch size to 0.023 for the 30-inch size. Some of the results obtained are highly important from the standpoint of practical construction and already have been made use of in connection with the design of culverts for Federal-aid projects. The results obtained also bear directly upon the design and capacities of pumping plants, tide gates, sluice gates, and tile drains, and the application of the results in designing and constructing such improvements will materially reduce the cost of such structures.

The results with concrete, vitrified clay, and corrugated metal pipe culverts 30 feet long with straight end-wall entrances and varying in diameter from 12 inches to 30 inches show that a 12-inch vitrified-clay pipe culvert with beveled lips upstream will carry about 65 per cent, an 18-inch clay pipe culvert about 50 per cent, a 24-inch clay pipe culvert about 40 per cent, and a 30-inch clay pipe culvert about 30 per cent more water than corrugated metal pipe culverts of similar sizes, while a 12-inch concrete pipe with beveled lip end upstream will carry about 49 per cent more water, an 18-inch concrete pipe about 40 per cent, a 24-inch concrete pipe about 36 per cent, and a 30-inch concrete pipe about 32 per cent more water than corrugated metal pipes of the respective sizes.

By merely rounding the entrance to a 24-inch vitrified clay pipe culvert the capacity may be increased approximately 13 per cent over that obtained in a square entrance. By increasing the area of the cross-section of the outlet end of an 18-inch vitrified clay pipe culvert so that the area is about double and the angle of divergence about 10°, the discharge of the culvert, when the outlet is submerged, may be increased 40 per cent over that obtained in the same culvert having a uniform bore throughout.

The utilization of the data obtained in culvert design enables an engineer to increase the carrying capacity of culverts 40 to 50 per cent over former standard practice with a comparatively small increase in cost. It is proposed to continue the investigations to include box culverts.

At the laboratory at St. Paul, Minn., maintained jointly by the bureau, the University of Minnesota, and the Minnesota Department of Drainage and Waters, the investigation of the problem of the disintegration of concrete tile by alkali was continued. Experiments were also made on the effect of freezing on clay tile. One of the important phases of the work at this laboratory has been the working out of a method of measuring the progressive decrease in crushing strength of specimens of concrete when subjected to alkali conditions simulating as closely as practicable those of ordinary bad field conditions with respect to alkali.

It was found after extensive tests that the increase in volume of a specimen—this increase being determined by accurately measuring the increase in length—bears a relation to the decrease in crushing strength. By this means it is possible within limits to determine at any time the strength of a specimen without testing it to destruction. A series of tests has been conducted to determine the influence of consistency, mixture, and curing conditions on resistance to disintegration. It is yet too early to show the complete results of these experiments, though in general they indicate that consistency is the least important of the three variables mentioned. The amount of cement in the mix and the curing conditions evidently have a far-reaching effect upon the life of the specimen. It appears evident, however, from the work to date that the influence of both these factors on the resistance to disintegration is quite limited. Some 1,800 samples of concrete drain tile in use in the alkali-infested region have been tested with a threefold object in view: first, to ascertain the quality of tile in general use in the State; second, to determine how concrete tile so tested compared with laboratory-made specimens; third, to promote a general improvement in the quality of drain tile used in the State. The data on the practical phases of the manufacture of tile have not been completely analyzed, but it is not too early to state that a fundamental fault in the present method of manufacturing small-sized concrete tile in the ordinary packerhead machine is the very dry mix necessary in order that the jackets may be easily stripped.

One of the first essentials for better concrete tile in the smaller sizes is better manufacturing method. This fact is realized by many of the manufacturers of concrete tile in Minnesota and elsewhere who have cooperated willingly in the work. When the work was started very little concrete tile was being manufactured that would pass the requirements of the American Society for Testing Materials

for drain tile. Partly as a result of our work, the general character of tile has been improved, until at the present time most of the large tile manufactured passes the American Society for Testing Materials standards without difficulty, and some of the plants are able to meet specifications requiring an absorption of not more than 8 per cent. The quality of the small tile has been improved somewhat, but there is still need for much experimental work before an entirely satisfactory product will be secured.

In addition to the laboratory work, a water survey was made through the Red River Valley as far north as the Canadian line, with a view to determining the limits of the area impregnated with dangerous alkali salts.

It is hoped that the final result of the work at this laboratory will be to develop a commercial method of manufacturing drain tile of maximum resistance to alkali salts and determine the area in which it will be unsafe to use concrete tile.

During the fiscal year 1923 a preliminary survey of the condition of concrete tile in the Southeastern States disclosed deterioration or failure in a number of instances. However, there was a lack of exact information as to the quality of concrete tile used in the tile lines inspected. As a basis for accurate observation there was laid in January, 1923, on a farm near Wilson, N. C., an experimental drain composed of various makes of concrete tile of known quality, some being given protective coatings prior to laying. Each of the tiles laid was tagged for future identification, and the line will be inspected from time to time to determine the condition of the tile and whether the soil constituents have any apparent effect on the tile.

Run-off investigations were continued throughout the year, the most notable work being done on the Little River drainage district in southeast Missouri, where studies were made on both the large flood way and the smaller tributaries. Rainfall conditions were such that no conclusive data were secured with respect to the flood way. Still, the information obtained was sufficient to show that the coefficient of roughness or the resistance to the free flow of the water in flood ways is larger than is generally believed, and hence a larger coefficient of roughness will have to be used in designing such improvements than has been the custom in the past if the estimated carrying capacity is to be obtained.

A series of flood flows from drainage ditches in the district yielded valuable information with respect to the maximum flow to be expected in ditches furnishing outlet for drained areas of flat bottom land. This information is at present being used in redesigning the drainage improvements for the Little River district and for a number of districts in northeastern Arkansas. Measurements have also been made of the flood flow from a small hill watershed of 150 acres. The results obtained show the maximum rate to be much larger than was generally supposed for the locality. This information will be of special value in designing road culverts.

A continuation of the study of the effect of tile drains on the soil, conducted at the Coast Experiment Station in Summerville, S. C., in cooperation with Clemson College, demonstrates that tile drains properly installed are very effective where a good outlet is available. However, there is a considerable area in the Coastal Plain where outlet facilities are not available under present condi-

tions, and this condition exists at the Coast Experiment Station during periods of heavy precipitation. To obtain suitable outlets it will be necessary to organize community projects, such as are provided for in the various State drainage laws. The work also demonstrated that in the South, at least, the soil-warming effect of tile is not important.

An interesting investigation during the year was that relating to the drainage properties of the "buckshot" soils of the Yazoo Delta, Mississippi. It has been maintained by many in that section that tile is ineffective in such soils. A representative of the bureau, detailed to inquire into the situation, found that in all cases the ineffective drains were improperly placed and that in fact large numbers of drains in that soil, where properly designed and constructed, give entire satisfaction.

With the cooperation of a prominent sugar-cane planter in Louisiana an investigation of the value of irrigation of cane was undertaken. The abnormally wet season rendered the experiment inconclusive, but it was clearly demonstrated that the problem involves drainage as well as irrigation, the object being to maintain through both these agencies just the right soil-moisture content. One problem involved is to develop methods of irrigation and of drainage that do not interfere with each other or with the cultivation of the cane crop. This investigation will be continued.

Drainage projects in which utilization of the land depends upon immigration from other regions have been too generally unsuccessful in accomplishing agricultural development and often have been attended with losses to investors who have financed the enterprises and to settlers who have attempted to make homes upon the land. It is evident that the causes of failure include unexpectedly large costs for reclamation, poorly selected settlers, lack of capital on the part of promoters and of settlers, sometimes low intrinsic value of the land itself, and in not a few cases greedy and unscrupulous dealing by the promoters. A study of the problems of land reclamation and settlement has been undertaken in cooperation with the Bureau of Agricultural Economics. Thus far a reconnaissance survey has been made of land reclamation and land settlement in the Southern States from the Potomac River to and including eastern Texas. This will show roughly the area and distribution of such enterprises in that region, the character of the land in the projects, the nature and cost of reclamation work generally necessary, the price of the land and the terms upon which it has been offered for sale, the kind of settlers or purchasers secured, the kind of agriculture practiced, and the success of the settlers in paying for their farms and in bringing the land into cultivation. Upon the results of this reconnaissance the bureaus will base a plan for thorough investigation of the engineering problems of land reclamation and settlement.

An investigation as to where and to what extent progress has been made in drainage during the years 1920 to 1922, inclusive, was begun. To secure the information an inquiry was addressed to an appropriate official in each county in all the Southern, Western, and Central States. The information will include approximately the number of drainage districts or other public land drainage projects, the area embraced in or assessed for each, and the cost of the improvements undertaken.

The first drainage district organized in Alabama revealed the fact that the State drainage law was unsatisfactory. The procedure for organizing and operating a district was cumbersome, the method of financing was expensive, and the bond issue was not suitably secured. At the request of the State authorities assistance was given in rewriting the laws, making changes which made the procedure more simple and the bond issue more secure.

The extension work undertaken was, as in former years, done in cooperation with the State extension services. Individual assistance was rendered on great numbers of tile and terracing projects, and many preliminary examinations and reports were made on community projects involving the reclamation of swamps and stream bottoms. The interest in terracing as a means of preventing soil erosion is evidenced by the fact that during the fiscal year in Arkansas 650 demonstrations of terracing were given by county agents and 582 farmers were induced to build terraces. The total number of acres terraced in that State during the year was 26,913.

Consulting assistance was rendered during the year on several large community projects.

## FARM IRRIGATION INVESTIGATIONS.

One of the things the department undertook to ascertain when its irrigation investigations were first instituted was the duty of water, and the amount of water required in the successful irrigation of different crops under the various conditions of soil and climate of the arid and semiarid regions. Indeed, the principal work for several years centered in that determination. The investigational work has consisted of measuring the water applied to and wasted from selected fields under a great variety of soil, topographic and climatic conditions, more exact measurements of a like nature on small experimental tracts, and laboratory experiments with crops grown in tanks. Crop yields were recorded, together with soil analyses, soil moisture content, temperature, wind movement, and other data having a bearing on the water requirements of crops. The gross duty of water was determined by keeping records of diversions at canal intakes, and losses in transmission were also determined. The accumulation of these data, together with similar records collected by State and private institutions and individual farmers, has reached large proportions and covers a wide field, so that it is now possible to present the results in a form which should prove of great benefit to those interested in irrigation agriculture.

The importance of doing this is emphasized by the inquiries received for information from individuals seeking to reduce crop production costs by the more economical application of water and from State officials, courts, engineers, and managers of irrigation enterprises who must apportion the flow of streams, settle water rights, design conduits and structures, and store and distribute water supplies. In many of the more important irrigated regions the normal supply of water in the streams has been entirely appropriated and any further expansion of the irrigated area requires the construction of costly storage works, frequently at great distances from the lands to be irrigated. It is, therefore, of first importance to make available all possible information on the water requirements of crops.

Accordingly a series of department bulletins covering the whole subject of duty of water was begun during the past year. Five reports are being prepared, each covering one of the major drainage basins of the West. It is believed that the series can be completed during the fiscal year 1924.

The collection of data in regard to the financing and operation of irrigation districts was continued, and the manuscript for a bulletin on Irrigation District Operation and Finance, which presents in compact form the essential facts in regard to these districts, was completed.

The cost to the settler of establishing an irrigated farm—that is, of clearing it of native vegetation, leveling and otherwise preparing it for irrigation, constructing the necessary buildings, fences, and other structures, providing a domestic water supply, etc.—has been made the subject of special study for the past year or more. This investigation now forms a part of a nation-wide study of the cost of reclaiming desert, swamp, and cut-over land and is carried on in cooperation with the Bureau of Agricultural Economics.

The control of a large irrigation enterprise calls for business ability of the highest order. The completion of a canal system marks the period where the comparatively simple problems of construction end and the perplexing question of management begins. The bureau's division of irrigation investigations has started the collection of data regarding details of water delivery, methods and devices for water measurement, and the forms and devices which have been developed by canal companies to keep track of their business, and will prepare for publication a report based on the study.

Especial interest has developed lately in the possibilities of raising large quantities of water from streams, reservoirs, and lakes by pumping. The division of irrigation investigations has in hand a study of the efficiencies and other qualities of such large-scale pumping installations, with a view to the introduction of improvements in their design, manufacture, installation, and operation.

The investigation of the flow of water in steel pipes was continued. Field investigations were practically completed during the year, and the preparation of the report was begun.

An investigation of flow in flumes of all types used to convey water for irrigation was begun. It is proposed to make a careful study of each type of flume, the conditions which suit it, its purpose and serviceability, and to follow this examination with an accurate test of the carrying capacity under known conditions in order to determine its hydraulic elements. A bulletin will be issued giving the results of this investigation as soon as the field work has been completed and the data have been prepared for publication.

The bulletins on the flow of water in irrigation channels, in wood-stave pipe, and in concrete pipe which have previously been issued have been well accepted, and the formulas recommended therein are now in common use in the design of irrigation structures. The purpose of this work is to make available information enabling the engineer to design under known conditions conduits which are large enough (but no larger) to deliver the maximum quantity of water required.

An investigation of the principles involved in the design and construction of earthen dams and embankments intended for im-

pounding water, with special attention to percolating losses through such structures, was begun with a view to securing greater safety and efficiency. The project is cooperative in an informal way with the United States Reclamation Service, and several owners of structures where percolation losses have been costly are cooperating in the investigation.

A field study of the various types of chutes and drops in canals was practically completed. Special attention was given to the problem of eliminating erosion of banks of canals above and below the structures, a defect which has caused great damage to canals in the past. The results are nearly ready for publication.

A study of the rates of run-off that may be expected from drained irrigated land was begun. Many drainage districts have completed or are just completing their drainage systems, and these afford unusual opportunity for the collection of data in regard to the amount of water that must be removed under different conditions to provide satisfactory drainage of irrigated lands that have been or are becoming water-logged. Such data are of great value to the engineer intrusted with the design of drainage structures and when obtained will permit of much more accurate designing and consequent greater efficiency at lower cost than it has been possible to obtain in the past.

Field investigations for a bulletin on drainage structures were completed during the year, and the manuscript is partly prepared.

In response to a request from the sugar planters of Hawaii arrangements were made by which an engineer was detailed to make an examination of drainage conditions on a number of plantations in the Hawaiian Islands. The field investigations were completed, and a report thereon is in preparation. The investigations indicate that with improved drainage conditions some lands which are not now well adapted to the raising of sugar cane may be made suitable for that crop.

In cooperation with the Colorado Experiment Station the following investigations were continued:

1. Hydraulic experiments at Fort Collins. The major work involved tests of various types of water-measuring devices and the development of new ones. Considerable work was done on a weir of the Hershel hollow-crest type in an effort to develop a satisfactory device which will register accurately when partly submerged by back water; conclusive results were not obtained, and the work will be continued during the coming year on a modified form of this weir. The activities embraced also: Perfecting of a device which will accurately divide or apportion a stream of water in certain ratios; assembling under suitable conditions at the hydraulic laboratory various types of water-level recording and measuring devices for comparison as to accuracy, reliability, sensitiveness, action under varying conditions of increasing and decreasing head, etc. A manuscript for a bulletin giving the results of tests on the water-level recording instruments is nearly completed.

2. A study of evaporation from water surfaces and of the various factors which influence the rate of evaporation was made for the purpose of developing an empirical formula by which the amount of water evaporated from a water surface in a given time can be determined with reasonable accuracy. The work is being carried on in both laboratory and field. In the work in the laboratory it is possi-

ble to control conditions closely, and this permits the determination of the effect of different factors that influence evaporation. Considerable progress has been made with the study, which will be continued.

3. As a part of a comprehensive study of the growing of sugar beets in the Arkansas Valley undertaken by various agencies, studies were made in regard to the relation of soil moisture, drainage, duty of water, and method of application of water to the production of sugar beets.

In cooperation with the Nevada Agricultural Experiment Station a study was made to determine by means of pumping the capacity of nonflowing wells in southern Nevada. In the cases of two nonflowing wells of the artesian type it was found possible to increase the yield from 2 to 8 miner's inches in one and from 2 to 10 miner's inches in the other. As the water supply in southern Nevada is limited and valuable and controls, to a large extent, the agricultural production of that section, the development of even small supplies is a matter of considerable importance. The work is to be continued during the summer of 1923 with better equipment, and it is hoped to secure even greater increases in yield.

Studies of the duty of water for various crops are also in progress.

In cooperation with the Utah Experiment Station the following work was carried on:

1. The reorganization and consolidation of irrigation enterprises. On account of the peculiar conditions as regards irrigation practices in Utah no other subject seemed so important as the merging in each favorable locality of a number of small independent systems diverting water from the same stream into one effective organization. To carry out a task of this character successfully requires the consent of the large majority, if not all, of the landowners involved. Satisfactory progress has been made during the year in an effort to remodel the irrigation systems of four communities. The nature of this work can best be told by a brief reference to what has been accomplished in each of three localities during the year.

(*a*) One locality, formerly served by three separate irrigation systems and three different classes of water right, has been placed under one mutual water company and is operating as a single unit with only one class of water right. To cite some of the beneficial results of such merging, the effective use of water has been increased 50 per cent, the reservoir has been enlarged 33 per cent, additional storage facilities have been surveyed and planned, and a considerable extent of new land can now be reclaimed by the more complete conservation of the water supply.

(*b*) In another locality which was formerly served by 10 irrigation enterprises having 11 classes of water right, the number of organizations has been reduced to two, one covering all primary rights and the other all high-water rights. In this way water can be delivered to the land more efficiently and the irrigated area increased.

2. A special study has been begun to ascertain the best and most economical means of constructing barriers across flood channels to check gravel flow and to determine the surface slope and the nature and extent of débris deposits laid down above such barriers. Many streams from which irrigation canals divert water carry large quantities of sand and gravel at high-water time during spring run-

off and are subject to heavy summer floods when large quantities of débris are carried into the main channels and deposited there. The subsequent spring floods carry this material into the canals and ditches or onto lands adjacent to the main channel. This problem has become serious, especially in parts of Utah, and the division of irrigation investigations, in cooperation with the Utah Experiment Station, has been instrumental in developing a remedy which promises to control the menace at low expense to the threatened communities. Under the direction of the department's representative suitable small basins have been selected for the retention of the gravel, and low crib dams of native timber, filled with rock, have been built across their lower levels in order to check the flood waters and permit the deposit of all the heavier and larger material. The demonstration dams so far constructed have attracted much attention and have proved even more effective than was anticipated.

3. A study of the efficiencies of the pumping plants in use in a number of wells was made, and some study was also given to the problem of developing ground water for irrigation purposes.

In cooperation with the agricultural experiment station and with the State engineer of New Mexico a study of the drainage conditions in the central valleys of the Rio Grande which has been in progress for several years was continued. Prior to the storage of water in the Elephant Butte Dam, which was completed in 1916, a large percentage of silt was transported with the water of the Rio Grande and applied to the surface of irrigated lands. One of the effects of this was to render the soil less pervious and decrease the losses due to deep percolation. With the subsequent use of stored water, containing little or no silt, deep percolation resulting from irrigation increased the percentage of waste water and caused a rapid rise in ground-water levels. This condition was rendered more acute by the enlargement of channels, which increased seepage losses, and by the further fact that much more water being available a more liberal amount was applied. In 1917 about 64 per cent of the 90,000 acres in the Mesilla Valley was water-logged to a greater or less degree. Other valleys along the Rio Grande were also menaced by rising ground water, but not to the same extent. This water-logging of improved lands continued to grow worse until 1919, when the Reclamation Service began the construction of deep, open drains in the Mesilla Valley, which soon became effective in lowering the ground water.

It was for the purpose of rendering some assistance that this bureau entered into the cooperative relations mentioned above. As a result a large amount of data, obtained from test wells, has been collected and tabulated. In 1921 a report on the drainage of Mesilla Valley was published as Bulletin No. 129 of the New Mexico Experiment Station.

Since that time cooperative efforts have been occupied largely in studying drainage conditions in the central valleys of the Rio Grande in New Mexico in the hope that the landowners would unite and organize a number of drainage districts. Field data on this project were nearly completed during the past year, and preparation of a report was begun.

In cooperation with the Agricultural Experiment Station of New Mexico, investigations pertaining to the use and duty of water were continued during the year. In order to make the work more effective the investigations were conducted in cooperation with the

departments of agronomy and horticulture of the agricultural college.

In cooperation with the Board of Water Engineers of Texas, a study of seepage losses from irrigation channels of various kinds is in progress in the lower Rio Grande Valley. In this valley the irrigated lands have in some instances two slopes, one away from the river and the other in the direction of its course, the latter being about 1 foot per mile, while the former varies from 6 inches to 4 feet per mile. At the upper end of the valley, near Mission, the ground slopes away from the river at the rate of about 6 inches per mile for a distance of 4 miles to what is known as the second lift. At this point there is an abrupt rise of 32 feet, from which elevation the surface slopes to the north 2 feet per mile for 4 or 5 miles to a third lift of about 30 feet. These topographical features make it necessary to operate canals on made embankments at the river end, and the enormous loss by seepage, together with the cost of pumping part of the water through a succession of lifts, render the cost of water to farmers quite high. It is hoped that the investigations now in progress will result in the application of remedial measures which will lessen the present burdensome cost of water.

In cooperation with the department of public works and the University of California, three major projects were carried on. These were: (1) A study of seepage losses in irrigation channels and economic means for their prevention; (2) a study of the use of irrigation water and its movement in the soil in relation to the duty of water, to its utilization by plants, and to alkali injury; (3) a study of the cost of water to irrigators. None of these projects was brought to completion during the year, but it is expected that investigations of the seepage losses in irrigation channels and of the cost of water to irrigators will be completed during the coming year and reports thereon issued.

## FARM ENGINEERING INVESTIGATIONS.

The ventilation of farm dairy barns is an engineering problem the importance of which is not generally realized by those engaged in the production of milk. The best methods of maintaining proper atmospheric conditions within the barn have not yet been found, because the basic principles involved have not been determined. It has been found that, just as fresh air is necessary to the health and efficiency of human workers confined in close quarters, so it is essential, particularly in cold climates, to the health of farm stock if the milk and meat supply of the country is to be clean and wholesome. It is known that animals do better if the stable is kept dry and at a comfortable temperature. The maintenance of such stable conditions is dependent upon a number of factors the relation of which to one another and their respective effects upon the ventilation of the stable have not been clearly determined. Investigations previously made were for the purpose of obtaining general data and determining the constancy of certain factors. During the past year these investigations were supplemented by a number of tests designed to corroborate or disprove some of the earlier findings. A large amount of data secured in these tests is being analyzed and it is expected that facts of great value to agricultural engineers and designers of ventilating systems will be de-

veloped. A farmers' bulletin explaining the general principles underlying the ventilation of barns and discussing the systems of barn ventilation in common use has been submitted for publication as a guide to farmers in the operation of ventilating systems.

An investigation made in cooperation with the Virginia Agricultural Experiment Station with respect to the possibilities in the development of power from farm streams resulted in the preparation of a bulletin explaining the method of determining the power available and estimating the amount of power required, the types of apparatus used in transforming water power into electrical energy, the construction of simple dams and offering other helpful information with suggestions relative to the development of power from small streams.

At a meeting held in Chicago in March, 1923, representatives of the United States Department of Agriculture, the American Farm Bureau Federation, the American Society of Agricultural Engineers, and the National Electric Light Association discussed the use of power, particularly electricity, in agriculture, and organized the committee on electricity and its relation to agriculture. The committee found that although the development in American agriculture has been due, in large measure, to the application of power to agricultural production, no comprehensive study has been made of the extent, distribution, and cost of such power. As the use of power will unquestionably increase, the committee thought it highly desirable that the farmer and others interested should be fully informed as to the possibilities and limitations of various sources of farm power, and that the information be in such form that the farmer can apply it to his individual problems. A very comprehensive program of investigation was adopted, in which the Department of Agriculture and the various agricultural experiment stations are looked to for research information on fundamental agricultural problems. As one step in this connection, the farm-power committee of the Department of Agriculture was requested to undertake a survey of the use of power on farms and of the agricultural uses of electricity in foreign countries. The division of agricultural engineering of this bureau, for the farm-power committee of the department, has made arrangements to begin this survey as soon after July 1 as possible.

Good concrete as building material has qualities, particularly that of permanency, which make it most desirable for many small farm structures. If the concrete is not of good quality and properly placed, failure and possibly serious loss may result. A bulletin, now available, explains the principles and methods of making good concrete for any ordinary purpose. To supplement this there was prepared another bulletin describing and illustrating the construction of walks, floors, small tanks, manure pits, and dipping vats which may well be made of concrete because of its durability.

With a view to assisting the many farmers who, if they are to equip their homes with modern conveniences, must do the work themselves, there was prepared and sent to the printer the manuscript for a farmers' bulletin on plumbing. Much has been written regarding city plumbing practices, but very little comprehensive information has been published that would enable the farmer to work out his own special problems. He can not readily obtain the free advice of city plumbing and water departments and it is often impossible or too costly to employ an experienced plumber. Above

all others, the farmer must rely on his own judgment. Above others, his plumbing installation should be simple, serviceable, safe, and inexpensive. This bulletin supplies just the information needed. Simple directions are given for determining pipe sizes. The most suitable fixtures and kinds of pipe with costs are discussed sufficiently to enable anyone to choose wisely. Plumber's tools and their use and methods of roughing-in, supporting, and protecting plumbing from frost are discussed and illustrated. The housewife will especially apreciate the sections devoted to hot-water supply and to care of plumbing fixtures necessary to preserve their life and sanitary qualities. The bulletin contains many illustrations and will go far toward enabling any farmer who so desires to do his own plumbing. It will prove useful whether the house is humble or pretentious, whether old plumbing is to be renovated or new is to be installed. Improper plumbing may be a source of great annoyance, if not a danger to health.

Lantern slide series No. 104, comprising 48 slides with syllabus entitled "Farmstead water supply," was prepared for the States Relations Service.

Further study and analysis of data obtained in previously made investigations of the use of tractors led to the preparation of a bulletin on the utilization and cost of using tractor-drawn implements. The manuscript has not yet been submitted for publication, but it is thought that the bulletin will be helpful to those who practice power farming or who contemplate a greater use of power.

Whether a motor truck would prove a profitable investment is a question that is something of a stumblingblock to many farmers. The experiences of a large number of farmers in the New England and Central Atlantic States have been put into a bulletin, which has been submitted for publication. The report, which brings up to date data contained in a previous bulletin, should be of material assistance to those who are considering the purchase of a truck.

Other bureaus of the department are engaged in investigations which involve the erection of specially designed buildings or equipment for experimental purposes. Plans for such construction were prepared by this bureau. The new central heating and power plant and an auxiliary water-supply system at the Arlington Experimental Farm were the most notable undertakings of this kind. The results of other investigations of several bureaus affect the design of farm and rural industrial structures. In cooperation with those engaged in such investigations this bureau has prepared building plans and designs of minor equipment.

Continuing the cooperation with the Bureau of Entomology in cotton-boll-weevil control, this bureau assisted in the engineering work involved in the investigations. The work of the year included the development of mechanical apparatus for the distribution of calcium arsenate from airplanes, as there was no apparatus available that was suitable for this work. A public patent on the distributing apparatus was secured. An investigation of types of airplanes to determine the one best suited to dusting cotton was made. The experimental work with airplanes has opened up new possibilities in the development of dusting machinery and may result in the development of new types of machines, better adapted to the

work than those now available. The examination of new types of dusters submitted by manufacturers, with suggestions as to modifications, was continued, as was the policy of conferring with and advising planters in regard to dusting operations. The text of a bulletin published during the year tells of the development of cotton-dusting machinery.

The work of the bureau in cooperating with the Bureau of Plant Industry in the investigation of fruit and vegetable storage and transportation was largely of an advisory or consulting nature, and had to do particularly with the plans for a proposed precooling plant to be erected in Porto Rico and the refrigeration equipment of steamships engaged in transporting citrus fruit from Porto Rico. In the latter instance recommendations were made which would permit of a saving of 23 per cent of the space devoted to refrigerating equipment in the plans submitted by the builders, as well as more effective operation of the refrigerating plant with less danger of damage to the cargo by freezing. Assistance was given in the preparation of experimental shipments of strawberries in refrigerator cars for the purpose of studying transit temperatures and refrigeration conditions. Inspections were made of citrus precooling plants in Florida and plants in Michigan used for precooling of berries and other small fruits. The few tests made were suggestive of certain possibilities, especially with respect to the precooling of citrus fruits in Florida, where the refrigeration of the air blast is accomplished by means of cold brine sprayed directly into the air. The brine-spray method may well be closely studied, as it seems probable that it will have a very distinct field, especially in connection with precooling and possibly also with the economical and effective cooling and humidification of storage rooms. Investigations in fruit storage included studies of the performance of two small apple-storage cellars in which underblast ice and salt systems of cooling had been installed upon the advice of the department. In both cases the results were not altogether satisfactory from an engineering standpoint, owing to abnormal conditions and poor workmanship in construction. It is hoped that further work at these two plants will develop valuable data bearing on the design of plants of this character.

Studies of the precooling of grapes were made at Dinuba, Calif., but due to the shortage of cars in the fall of 1922 it was impossible to carry out the work as planned.

An investigation of the problem involved in the transportation of broccoli was undertaken and completed in the spring of 1923, and data of much value to the growers secured. An investigation of the precooling of small fruits and cherries was in progress at the close of the year.

As an inevitable and very desirable result of the activities of the bureau in the investigation of farm engineering problems, it is called upon by farmers and others for information of great volume and variety and for assistance in the solution of many problems of a specific nature. This phase of the work of the bureau has grown to such proportions that it seriously interferes with the progress of important investigations by the technical personnel engaged in farm engineering work.

Although the bureau has prepared and has on hand a considerable number of plans of farm buildings which are available to those

farmers who contemplate building, they do not meet the requirements of all sections of the country, owing to the varied conditions of climate, availability of materials, and farm practices. Many of the agricultural engineering departments of the State colleges maintain a plan service designed to meet local conditions, but because of limited resources they, as is the case with this bureau, can not by any means cover the whole ground. The problem of maintaining an adequate service has been giving the agricultural engineering departments of the colleges and of this bureau much concern. The college section of the American Society of Agricultural Engineers has appointed a committee, on which the bureau has a representative, to study the problem. A scheme for the interchange of plans is being developed which it is thought will make available a larger number of plans, prevent duplication, and generally result in more effective service at a lower cost.

## DISTRIBUTION OF SURPLUS WAR MATERIALS.

The distribution of surplus war materials both for road work and agricultural purposes, which was continued during the year, has been attended by the same satisfactory results that have characterized the previous distribution. The recipients, whether State highway departments or individual farmers, have been uniformly pleased and gratified with the savings they have been able to make by the use of the salvaged material.

The value of the road-building material delivered to State highway departments during the year was approximately $58,111,836. The material retained by the Department of Agriculture was estimated as worth $200,000, making the total value of the delivered material approximately $58,311,836. The total value of all material delivered up to the end of the fiscal year, including that delivered in previous years, was $208,559,572.

The distribution of the material delivered up to the end of the year is shown in the following table:

| State. | Value of material delivered during fiscal year. | State. | Value of material delivered during fiscal year. |
|---|---|---|---|
| Alabama | $2,749,120 | New Jersey | $2,983,675 |
| Arizona | 3,386,212 | New Mexico | 3,223,126 |
| Arkansas | 2,808,318 | New York | 11,199,243 |
| California | 6,683,126 | North Carolina | 5,322,884 |
| Colorado | 4,410,311 | North Dakota | 1,771,696 |
| Connecticut | 1,211,514 | Ohio | 7,912,233 |
| Delaware | 449,186 | Oklahoma | 3,272,545 |
| Florida | 2,926,687 | Oregon | 3,128,457 |
| Georgia | 6,044,232 | Pennsylvania | 7,593,871 |
| Idaho | 2,008,320 | Rhode Island | 666,820 |
| Illinois | 9,254,516 | South Carolina | 2,919,495 |
| Indiana | 6,837,540 | South Dakota | 3,994,136 |
| Iowa | 6,127,632 | Tennessee | 5,423,817 |
| Kansas | 5,710,378 | Texas | 11,855,230 |
| Kentucky | 2,695,590 | Utah | 1,604,110 |
| Louisiana | 2,896,643 | Vermont | 1,078,465 |
| Maine | 1,754,877 | Virginia | 4,590,277 |
| Maryland | 2,654,764 | Washington | 3,473,544 |
| Massachusetts | 2,276,507 | West Virginia | 3,976,263 |
| Michigan | 8,063,235 | Wisconsin | 5,485,978 |
| Minnesota | 5,299,678 | Wyoming | 1,678,227 |
| Mississippi | 3,462,881 | | 197,885,822 |
| Missouri | 5,658,976 | | |
| Montana | 2,690,766 | Retained by Department of Agriculture | 10,673,750 |
| Nebraska | 3,636,807 | | |
| Nevada | 2,171,346 | Grand total | 208,559,572 |
| New Hampshire | 862,568 | | |

The motor vehicles, trucks, and automobiles included in the material appear as the greatest single item and have attracted the greatest amount of public attention. There is no doubt that by their acquisition many of the States have been able to keep abreast of their maintenance requirements, which otherwise would have had difficulty in providing for suitable repairs on account of limited appropriations. But the miscellaneous material, especially the shop equipment, has also been of almost inestimable value to the State highway departments.

The experience of New Hampshire is typical of many other States. The highway department, in a recent report, states that prior to the distribution of war materials the department's motor vehicles consisted of 3 trucks and 4 touring cars which were housed in a small garage about 40 feet square. When breakdowns occurred, which were frequent, the disabled cars or trucks were hauled to local garages for repair. The New Hampshire department now has 27 touring cars and 137 trucks housed in new garages which include a repair shop, machine shop, carpenter shop, and testing laboratory, all fully equipped, in large part with surplus war equipment. Since the machine shop has been installed the department is now able to make new parts, thus eliminating delays and reducing repair charges to a minimum.

The benefit of the salvaged machinery is felt in other ways as well; for example, the grade stakes which the State formerly bought at $18 a thousand, it now makes for $8 a thousand. Bridge forms for superstructures, formerly built at the job under adverse conditions by hand, are now made at the shops and carried to the job on Army trucks all ready for assembling. These are only a few of a number of instances of direct benefit cited which show that the surplus war material has been of the utmost value to this State; and similar reports have been received from other States, which show that New Hampshire's experience has not been exceptional.

As another instance, Rhode Island reports that "all things considered, the motor vehicles received from the Federal Government through the Post Office appropriation act have been of inestimable value, and considering the labor conditions and the scarcity of horses during the past three years, it is practically impossible to conceive of the progress we would have made on maintenance and general transportation without these Federal trucks or other motor vehicles purchased with our highway funds." Further along in the same report this statement is made: "We regret that our main shop was largely equipped before the machine tools were opened for distribution. Otherwise we would have been able to have equipped our whole main shop from this source."

Much of this material the Government was urged to sell at junk prices. Its utilization by the States for the useful purpose of highway construction is clear gain to the country.

An illustration of the advantage to the taxpayers is found in the case of one of the recent offerings. At the end of the war the Army had left over more than a half million pounds of rough castings of spare parts for one of the well-known makes of motor trucks. They were badly rusted and on casual inspection might have been condemned as worthless junk, but it was found that the necessary machine finishing would entirely remove all rust and

pitted surface and make them as good as new. The War Department was urged to sell them and an offer of 1 cent a pound was made, which the department refused. A few months ago the State Highway Department of North Carolina accepted a portion of them as part of its share of material. It put them through its machine shop, equipped with surplus war machines, and is now using them, with entire sastisfaction, to replace worn parts in the trucks which were also received from the Government. The finished parts are worth about 75 cents a pound, as compared with the offer of 1 cent a pound made by the junkman. Other States have followed North Carolina, and the entire supply of these parts has been taken up and will be put to useful service. Instances of this sort could be multiplied almost without end.

#### DISTRIBUTION OF SURPLUS WAR EXPLOSIVES FOR USE IN LAND CLEARING.

The distribution of surplus war explosives to farmers for land clearing has been of great value in stimulating the efforts of new settlers on cut-over lands in the Lake States to clear more land and to develop their farms to the point where they would make their owners self-supporting. The wide publicity given to the distribution of these explosives also brought to the attention of many farmers the possibility of removing, at little cost, the stumps and stones from cultivated fields. Of the original stock of picric acid (approximately 12,500,000 pounds) available for distribution, slightly more than 500,000 pounds remained at the close of the fiscal year. Since the work was begun a total of 7,444,350 pounds has been distributed for agricultural uses and about 4,000,000 pounds have been used for other purposes, chiefly road building.

During the year there was distributed, chiefly through the agricultural colleges, 4,179,550 pounds of picric acid for agricultural uses, principally land clearing, as follows:

| | Pounds. | | Pounds. |
|---|---|---|---|
| Alabama | 100 | Mississippi | 18,000 |
| Arizona | 1,100 | Missouri | 25,100 |
| California | 18,000 | Nebraska | 67,000 |
| Connecticut | 17,000 | North Carolina | 107,950 |
| Georgia | 40,000 | Ohio | 20,000 |
| Iowa | 82,100 | Oklahoma | 400 |
| Kentucky | 33,000 | South Carolina | 16,700 |
| Maryland | 500 | Tennessee | 36,200 |
| Michigan | 451,300 | Vermont | 3,200 |
| Minnesota | 627,900 | Wisconsin | 2,614,000 |

Early in the calendar year 1923 a supply of blasting caps became available. It was arranged to supply purchasers of picric acid with caps at the rate of approximately one cap for each pound of picric acid purchased. Under this arrangement 2,650,000 caps were distributed.

The picric acid has been supplied to farmers at no cost except the actual expense of preparing and shipping (6 cents per pound), a charge of 1 cent per pound to defray the administrative expenses of the bureau and State agencies, and the transportation charges. The caps were supplied the purchasers of picric acid without charge, but the user was required to pay the transportation charge.

That the distribution of picric acid has been of great benefit to the farmers interested is shown by the reports of the State cooperating agencies.

It would not have been possible to secure the distribution that has been made had it not been for the cordial cooperation of the various State agencies. In Michigan, Minnesota, and Wisconsin intensive campaigns were organized by the cooperating agencies to promote the use of picric acid by landowners who had need of it in connection with clearing stumps from their lands. In these States there has been an effort to clear more land on farms where the acreage was either too small to make the farmers self-supporting or was so obstructed by stumps and stones as to prevent the use of modern farm machinery. Since the distribution of picric acid was begun, approximately 25,000 farmers in Wisconsin have cleared 125,000 acres of new land and have finished clearing 25,000 acres of partly cleared land at an estimated saving of $400,000 through the use of picric acid instead of commercial explosives. The distribution has been general over the entire State, and orders for picric acid have been received from 67 of the 71 counties of the State. The bulk of the picric acid used in Wisconsin has, of course, been on the cut-over sections, but there has also been a considerable amount of it used in the southern part of the State, where the farms are older and generally better improved.

Since the distribution was begun in Michigan, 4,640 farmers have cleared 31,000 acres of cut-over lands and have removed the remaining stumps from 18,000 acres of cultivated lands at an estimated saving of $93,786. The specialist in charge of the work in Michigan states that 100 per cent more land was put in cultivation in the cut-over areas than there would have been if no war salvage explosives had been used. When it is realized that the bulk of the work was done on farms with less than 20 acres cleared, its value in making the farmers on these farms self-supporting becomes more apparent.

In Minnesota a vigorous and successful campaign has accomplished a great deal, but, unfortunately, the report of their activities has not been received.

North Carolina, through the State agricultural college, has conducted a campaign to have the farmers of that State clear the stumps from their cultivated fields. Since the work was started in the State 637 farmers have removed the stumps from approximately 6,000 acres of cultivated land at an estimated saving of $34,500 by the use of picric acid instead of commercial explosives.

In Tennessee 200 farmers have cleared 4,000 acres of cut-over land and removed the stumps from 2,000 acres of cultivated lands and have constructed approximately 55 miles of drainage ditches. It is estimated that by buying picric acid instead of commercial dynamite a saving of $8,000 was effected.

In Kentucky 115 farmers have cleared the stumps from 4,253 acres of cut-over and cultivated lands.

In other States the distribution of surplus war explosives accomplished somewhat similar results. The distribution of this picric acid has been helpful in many ways. In the Lake States it has served to stimulate the general land-clearing program which has been carried on in these States and which has for its purpose the clearing of more acres on farms which at present are being operated inefficiently or at a loss either on account of too small acreage or the attempt to farm lands where stones or stumps prevent the use of modern machinery and methods. It has also been very helpful in educating the farmers, pursuading them to improve conditions on their lands, and

leading them to use modern explosives, and has shown many that some work formerly done by hand labor could be done much more efficiently by the use of explosives. North Carolina, for instance, reports that every farmer from whom they have secured a report states that after using the supply of picric acid, he had purchased commercial explosives to continue the work.

It is estimated that the use of picric acid instead of commercial explosives has resulted in a saving to the farmers who have used it of approximately $800,000.

As soon as the distribution of the picric acid is completed it is planned to undertake the distribution, in a similar manner, of 18,000,000 pounds of sodatol. Sodatol is a mixture of trinitrotoluol (T. N. T.) and sodium nitrate. Tests indicate that it will be a very satisfactory explosive for land clearing. Bids for preparing and cartridging the sodatol will be opened in July, 1923. As the T. N. T. is stored at the arsenal near Sparta, Wis., and the sodium nitrate at Nashville, Tenn., the freight rate on the sodatol should be much lower than on the picric acid, which it was necessary to ship from Wingate, N. Mex.

## EXTENSION ACTIVITIES.

The educational extension work has been continued by means of lectures and addresses, motion-picture films, models, and other exhibits at fairs and expositions, farmers' and department bulletins, and contributions to the engineering and popular press.

Ten sets of small models of various types of roads and bridges, especially made for the purpose, were loaned to more than 80 universities and colleges for use in connection with the course in highway engineering. The models were routed to the institutions in accordance with a prearranged schedule by the highway education board, on which are represented, in addition to the bureau, the United States Bureau of Education, the War Department, the Society for the Promotion of Engineering Education, and various industries interested in the development of an adequate highway system. Authorities of the institutions to which the models were loaned reported that the service thus rendered was distinctly helpful and it is likely that the plan will be continued.

Arrangements have also been made to supply the schools during the coming year with sets of lantern slides especially prepared to illustrate lectures on all the important types of road construction. These slides, accompanied by the outline of a lecture covering each type of road, will be circulated to the institutions desiring them without cost, except for expressage.

In addition to the exhibits displayed at State fairs under the auspices of the office of exhibits, the bureau also prepared large exhibits for various highway conventions and automobile shows. The more important of these displays were made at the annual convention of the American Association of State Highway Officials at Kansas City, Mo.; the National Good Roads Show held under the auspices of the American Road Builders' Association in Chicago; the annual convention of the United States Good Roads Association; and automobile shows at New York, Chicago, Utica, and Newark. A special exhibit entitled "Three windows on the road," made for

the automobile shows, attracted attention as one of the most interesting exhibits wherever it was displayed. The exhibit represented three aspects of the service of modern highways. Through three windows the spectator was permitted to view the road in its relation to agriculture, rural social conditions, and city life.

In connection with the motion-picture section of the office of the Assistant Secretary, the bureau developed three new motion pictures during the year, and there are now available for loan 11 pictures dealing with practically all types of road construction, the building of roads in the national forests, and the experimental road investigations conducted at the Arlington Farm, Arlington, Va.

A number of department and farmers' bulletins were prepared during the year, several of which are referred to in connection with other sections of this report. One of the most important road publications of the year was Department Bulletin No. 1077, Portland Cement Concrete Roads.

Numerous special magazine articles, addresses, and lectures by the personnel of the bureau, and hundreds of short articles of an informative character issued through the press service to the newspapers of the country, keep the public informed of developments from the work of the bureau and add to the general knowledge of highway construction, maintenance, and administration.

# REPORT OF THE DIRECTOR OF THE FIXED NITROGEN RESEARCH LABORATORY.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
FIXED NITROGEN RESEARCH LABORATORY,
*Washington, D. C., September 13, 1923.*

SIR: I have the honor to transmit herewith the annual report of the Fixed Nitrogen Research Laboratory for the fiscal year ending June 30, 1923.

Respectfully,

F. G. COTTRELL, *Director.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

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## INTRODUCTION.

The entrance of the United States into the World War brought forcibly to the attention of this Government its serious unpreparedness in the matter of nitrogen, particularly for explosives. Other countries, with the exception of the Central Powers, had found themselves in a similar situation, and the universal rush to erect and place in operation plants for the fixation of atmospheric nitrogen is now a familiar story. The years following the war have added a chapter of no less interest, for they have seen the nations of the earth awakening to a realization that their peace-time requirements of nitrogen must come in increasingly greater proportion from sources other than the natural deposits. Thus, the past year has seen Germany operating fixation plants, the output of which has rendered her almost entirely independent of outside sources, and it is predicted that in the next few years she will be exporting large quantities of nitrogenous fertilizers. The growth of this industry in Germany can best be appreciated when it is pointed out that in 1910 Germany imported over 65 per cent of the nitrogen she consumed.

Although Germany has by far outstripped other countries in producing fixed nitrogen, many of the latter are making progress. This is most clearly shown by the fact that in 1920 more than 36 per cent of the world's production was supplied by the fixation of atmospheric nitrogen, having risen from little over 1 per cent in 10 years.

In the peace-time development of actual producing plants for nitrogen fixation this country has taken practically no part, less than 1 per cent of our present requirements being supplied by the fixation of atmospheric nitrogen within our borders. Meanwhile, the rapid growth in the use of fertilizers in the United States is repeating what has taken place in Europe. As the population increases, larger yields per acre become necessary. One way of accomplishing this is by the use of commercial fertilizers.

The present consumption of nitrogen in fertilizers in the United States is about 200,000 tons per annum. The capacity of the Government plant at Muscle Shoals, now idle, is 40,000 tons per annum. From 1899 to 1914 the consumption of fertilizer in the country practically tripled; i. e., an average rate of increase of 7½ per cent a year. The rate of increase during the last five years of this period was even greater. Since the slump in 1915 and 1916 further comparisons have been difficult, owing to the disturbed economic conditions throughout the world.

If the price of fertilizer were low enough, there is for practical purposes almost no limit to the amount that could be advantageously used as our people come to understand its use and importance. It has been estimated by Dr. Jacob Lipman, director of the New Jersey Agricultural Experiment Station, that the annual loss of nitrogen from all land under cultivation in the United States which is not replaced by manure, by the nitrogen supplied by plowing under leguminous crops, by atmospheric precipitation in the form of rain and snow, and by the present use of commercial fertilizer amounts to between 3,000,000 and 4,000,000 tons of nitrogen. To replace all of this would take from 15,000,000 to 20,000,000 tons of sulphate of ammonia, or from 150,000,000 to 200,000,000 tons of ordinary commercial mixed fertilizer.

It would not now nor in the immediate future be expedient to use fertilizer to any such extent on all of the land under cultivation, but these figures suggest at least an upper limit to the use of nitrogen in fertilizer, and show how far from that limit the present consumption is.

No large nitrogen-fixation industry exists in this country to-day. Our requirements for nitrogen are ever increasing, and these facts make it imperative that we have a thorough knowledge of all processes now in operation and vigorously prosecute research to keep us abreast of developments.

## ESTABLISHMENT OF THE LABORATORY.

After the armistice was signed, the Fixed Nitrogen Research Laboratory was established by the Secretary of War (March 29, 1919) in order to coordinate the knowledge which had been obtained concerning nitrogen fixation by the War Department during the war, to obtain further information necessary for the peace-time utilization of the Government nitrate plants at Sheffield and Muscle Shoals, Ala., and to study in general the fixation and utilization of nitrogen. On July 1, 1921, the Fixed Nitrogen Research Laboratory was transferred by Executive order to the United States Department of Agriculture. For the fiscal year July 1, 1922, to June 30, 1923, the laboratory began operation with a budget of $264,000. Economies in personnel, purchases, etc., reduced the actual expenditure to $217,000. Authority for this work is contained in the national defense act of June 3, 1916, specifically authorizing the President to "* * * cause to be made such investigations as in his judgment are necessary to determine the best, cheapest, and most available means for the production of nitrates and other products for munitions of war and useful in the manufacture of fertilizers and other useful products by water power or any other power."

Processes may conveniently be recognized as naturally falling into three categories, viz: (1) Processes which have attained a position of industrial importance, but from intrinsic limitations are apparently already past their zenith and doomed to displacement by more economical processes. (2) Processes already closely competing with those of class 1 and which present manifest opportunities for further fundamental improvements looking to cost reduction. (3) Processes not yet industrially competing with class 2, but out of which it seems possible that something still better may ultimately come. Of course, we must not expect to fit any particular process too exactly into the above classification; also, processes totally unsuited to the bulk of industrial production may prove the key to important special situations.

At the time of our entry into the war the three processes of nitrogen fixation claiming most attention for Government-built plants were the electric arc, the cyanamide, and the direct synthetic ammonia (Haber). Of these, the arc was quickly placed in class 1 on account of its very high power requirement.

The cyanamide process, which had definitely crowded the arc process out of class 2 because of the former's threefold greater energy, economy, and adaptability of products, was already recognized to have reached its probable limiting efficiency.

Even at that time there was much to indicate that the direct synthetic ammonia process, which was already operating on a commercial scale in Germany, would eventually displace the cyanamide process, just as this had displaced the arc process, and primarily for the same reason, viz, its smaller power requirements. The direct synthetic ammonia process was, however, still very new and wholly untried on a commercial scale outside of Germany. For this reason it was decided to put the main reliance for war purposes in the cyanamide process, which, though intrinsically more expensive on account of its larger power requirements, could be installed with absolute certainty of its working smoothly from the start, which could not be said at that time for the direct synthetic ammonia process, due to the more intricate character of its equipment and our lack of knowledge and experience concerning it.

### CYANAMIDE.

During the first two years, while the laboratory was still under the War Department and it was felt that the cyanamide plant at Muscle Shoals might at any time be called upon to start up under Government operation, the laboratory's attention was naturally directed largely to problems connected with the peace-time operation and possible improvement of the cyanamide process. These studies, while furnishing valuable data against the time of possible further operation of the large plant, have also confirmed the idea that the best chances for making further decisive cuts in the cost of nitrogen for fertilizer purposes lie along the lines of other processes.

During the past fiscal year additional data have been secured on the stability of calcium carbide at high temperatures, and upon the mechanism of the nitrification of carbide. In connection with this work a very accurate method for the determination of calcium carbide has been developed.

In addition to the study of the cyanamide process itself, the laboratory has also studied various products which may be made from cyanamide, such as dicyanodiamide, melamine, guanylurea, guanidine, and related compounds. During the past year our studies on cyanamide derivatives have been largely directed toward a summarization of the relationships existing between the various compounds in the series and analytical methods for their accurate determination. The results obtained should simplify to a considerable extent the problems of research in this field. Methods have been developed for preparing the ethyl ester of guanidine carboxylic acid, guanidine carbonate, and urethane. Some of the large number of cyanamide derivatives have already found distinct uses in the manufacture of military explosives, in medicine, and in the arts.

This class of compounds forms the natural starting point for a whole new field in chemistry, much as certain coal-tar compounds lay at the base of the present dyestuff industry. The sources of these compounds heretofore available have made them too expensive to be considered for wide uses, and the industrial aspect of this field in chemistry has therefore been slow of development. Now that the necessary raw materials can be obtained cheaply and in large quantities through cyanamide, this group of compounds presents a very attractive opportunity for industrial chemical research and development.

While it is not at all likely that the amount of nitrogen going into such products would ever approach the tonnage absorbed by the fertilizer industry, the aggregate value of the products might not be so disproportionate. So that while the fertilizer industry may draw its nitrogen supply in increasingly greater proportion from sources other than cyanamide, the latter may still have an important mission to perform in supplying the basis for these more specialized compounds.

The laboratory has made quite definite contributions to the chemistry of these cyanamide derivatives; but having thus opened the way and connected the subject with its other more basic work on the actual fixation of nitrogen, it is felt that further developments in this line may now very properly be left for the greater part at least to the research laboratories of the universities and the industries.

In experiments on the actual use of fertilizers, the laboratory has cooperated with the Bureau of Plant Industry. During the year a bulletin under joint authorship has been prepared and is now in press (United States Department of Agriculture Bulletin 1180) covering the results of field work for several years past on the comparison of the effects of cyanamide and various other forms of fixed nitrogen on different crops under a variety of conditions. One of the most promising developments of the work is the use of mixtures of cyanamide with neutral or basic phosphates. It had come to be generally assumed that about 60 pounds of cyanamide per ton of mixed fertilizer was an upper limit of good standard practice. This was based, however, almost entirely on experience with mixtures containing acid phosphate, which at present is used almost exclusively in this country. Experiments detailed in the forthcoming bulletin and which are being further checked and extended in the field seem to indicate that in the case of certain crops at least, notably corn, when acid phosphate is replaced by neutral or basic phosphates, such as calcined

phosphate rock or Thomas slag, a very much greater cyanamide content may be used safely and effectively.

If further work substantiates these indications, the results may be of very considerable importance in finding an outlet for the product of the cyanamide plant at Muscle Shoals, since the difference in cost of manufacture, even for a part of the product, as between cyanamide and ammonium salts may mean the difference between profit and loss.

### CYANIDES.

In addition to the cyanamide and direct synthetic ammonia plants near Muscle Shoals, the Government also, during the war, commenced the construction at Saltville, Va., of a plant for the fixation of nitrogen as sodium cyanide (Bücher process). Considerable difficulties were met with, and, although some cyanide was produced, the plant did not reach commercial operation before the armistice, shortly after which it was dismantled. When this process and plant were first considered it was thought by some that it might be possible thereby to pass from free nitrogen through cyanide to ammonia at a lower cost than through cyanamide, and even failing in this it would still be a cheaper process for reaching the cyanides and hydrocyanic acid.

By the time the construction of the Saltville plant was definitely started, however, the problem had narrowed down to simply producing cyanides for the needs of the Chemical Warfare Service, but the work at this plant by no means exhausted the experimental possibilities for the use of the reactions involved, nor did it furnish us with the fundamental knowledge of the exact mechanism of these reactions. The alkali cyanide reactions have the advantage over those of calcium cyanamide that they do not require electric-furnace temperatures, nor so great a power consumption, but they are incomplete, and the volatility of the substances introduces other complications. The laboratory work on these cyanide reactions which was originally laid out has during the past year been nearly covered, and it is hoped to complete this and publish the data secured during this coming year. In the meantime, one commercial company has established a plant in California and is manufacturing hydrocyanic acid, largely for fumigation of fruit trees. The work at the Fixed Nitrogen Research Laboratory has not furnished us with any particular encouragement for obtaining fixed nitrogen at fertilizer prices through any cyanide process operated primarily as such. There is, however, still the chance that these reactions, when occurring incidentally in other processes, particularly in the iron blast furnace, may, if proper advantage can be taken of them, be made to furnish crude cyanides as by-products at a low enough cost to permit of making ammonia for fertilizer.

It has been known for many years that in certain parts of the blast furnace considerable amounts of cyanides are formed by the alkalies and carbon in the charge taking up nitrogen from the blast, but in the normal running of the furnace these are volatilized and swept upward by the blast into zones of oxidation, where they are reoxidized to carbonates, thus again liberating the nitrogen. The idea of drawing off this material before it undergoes oxidation has long been suggested and even patented, but still awaits thorough large-scale experimentation and development. It happens to be a type of problem on

which decisive information can hardly be secured on a laboratory scale. Blast-furnace operations have to be on so large, continuous, and expensive a scale that it is difficult to find anyone willing and in position to undertake or permit experiments of this type on an operating furnace. However, it is now hoped that during the coming year such an opportunity may present itself through cooperation with the Bureau of Mines and the industry.

### DIRECT SYNTHETIC AMMONIA PROCESS.

One of the major problems of the laboratory has been the study of the direct synthetic ammonia process, frequently designated as the Haber process. An exhaustive study of this process was undertaken for two reasons:

1. The United States nitrate plant No. 1 was designed to operate in accordance with this process. In the test made on this plant it was found that successful operation was not likely until the chemical and engineering problems involved were more thoroughly understood.

2. The direct synthetic ammonia process is at present generally considered to be one of the most promising, if not the most promising, method for fixing atmospheric nitrogen. Although the chemical and engineering difficulties are serious, the process undoubtedly presents great possibilities for the lowering of costs. Therefore, irrespective of the immediate needs of the Government plant at Sheffield, the investigation of this process would still have occupied a large part of the research program of this laboratory.

The problems involved in the synthetic ammonia process may be divided into two groups, first, those which concern the process for making hydrogen combine with the nitrogen of the air to form ammonia, and, second, those which concern the process for manufacturing and purifying the hydrogen-nitrogen mixture employed in this synthesis.

The principal problem of the first group centers about the catalyst. In fact, the nature of the entire process is largely dependent upon its characteristics. For example, the properties of the catalyst determine what the purity of the hydrogen-nitrogen mixture must be. Since the purification of the gas represents a very large item in the cost of making ammonia by the process as employed at Sheffield, the importance of the catalyst is not to be underestimated.

Furthermore, the properties of the catalyst determine such factors as size of the catalyst chambers, the circulating system, and the heat interchangers. The nature of the apparatus for removing the ammonia formed also depends in large part upon the activity of the catalyst. With a poor catalyst the efficient removal of the ammonia becomes a very serious problem. The temperature at which the catalyst gives the greatest yield of ammonia is also an important consideration in the design and construction of the catalyst chambers. Briefly, we may say that every portion of the synthesis equipment is subject to modification as the character of the catalyst is changed.

Probably the greatest single contribution of this laboratory to date is the development of a very reactive and stable catalyst. As far as we have been able to learn, there is no country in the world which has an ammonia catalyst superior to that developed by this laboratory. A method has also been developed for manufacturing this material

which gives the necessary chemical control of the product and at the same time makes large-scale production possible. As a consequence, we are now in possession of such reliable information concerning at least one type of ammonia catalyst and its manufacture that one of the principal obstacles to the successful operation of such plants as United States nitrate plant No. 1 at Sheffield, Ala., has been removed.

There is still, of course, the possibility that a much more reactive catalyst may be found. As a consequence, this laboratory has continued during the past year its study of this phase of the problem. Before any marked improvement over the present catalyzers can be effected there must be a much better understanding of the way in which the catalyzer makes hydrogen combine with the nitrogen. Consequently, an extensive study of the mechanism of the reaction has been in progress. It is hoped that the results of this work may soon be published.

Although it is not too much to expect that painstaking research may reveal catalyst materials much more active than those which we have now discovered, it is felt that the greatest advances in the direct synthetic ammonia process within the near future may lie in the direction of increased pressures. Contrary to popular belief, there is nothing inherently impracticable in carrying out the synthesis of ammonia at pressures considerably in excess of those employed at Sheffield. During the past year tests have been made at various pressures up to 1,000 atmospheres. In these tests the activity and the longevity of the catalyst have been most satisfactory. From a chemical viewpoint there are many advantages to be gained by high-pressure operation, and when the engineering problems which arise at higher pressures have been solved there is the possibility that capital and operating costs can be very substantially decreased.

During the past year most of the demands for information concerning the synthetic ammonia process have come from groups particularly interested in the production of liquid ammonia from by-product or waste hydrogen. Liquid ammonia commands a price which makes the operation of small units (say 1 ton per day) commercially feasible. Much of the engineering research on the process during the past year has had in mind the special requirements of these small producers. While the amount of their product is insignificant compared to total national production, they would perform a highly important function in spreading knowledge and experience concerning the art in this country. As a result of this work we believe that the laboratory is now able to offer considerable assistance in the design of 1-ton plants.

The primary interest of the laboratory has been, however, the much larger problem of reducing the cost of fixed nitrogen suitable for fertilizer purposes. This study has involved a consideration of the advantages and disadvantages of operation at various pressures. The principal pressures suggested by the proponents of different systems for commercial operation have been 100, 200, 300, 600, and 1,000 atmospheres. Since the details of the process are determined in part by the pressure at which the process is operated, naturally the cost of producing ammonia may be expected to vary somewhat as the pressure conditions are changed. In making an analysis of the possibilities of operation at these various pressures, the laboratory has been considerably handicapped because of its inability to

obtain information concerning all the factors which enter into the cost of production. With its present facilities such items as labor and repairs can not be determined with certainty.

Much more rapid progress could be made if a large-scale plant were available in connection with whose operation varying pressure conditions could be studied. From the results of such a comparative study it would be possible to select a set of conditions which are best suited to the industrial conditions peculiar to the United States.

A project involving the examination of 25 alloy steels reached completion during the past year. In this test alloy steels suitable for the high-pressure, high-temperature synthetic ammonia reaction were exposed for about one year to a nitrogen-hydrogen-ammonia mixture at 500° C. and 100 atmospheres' pressure. As a result of this test an alloy steel suitable for use at 100 and possibly up to 300 atmospheres can now be recommended.

The investigation of methods for removing ammonia from the high-pressure circulating system of the direct synthetic ammonia process has been under investigation at this laboratory by the Bureau of Soils. This investigation was primarily designed to meet the particular needs of the Government plant at Sheffield. This project was completed during the year, and the results will soon be available.

Although the production of an efficient and dependable catalyzer was the necessary first step and key to the whole problem of synthetic ammonia, now that this has been accomplished the next and greatest opportunity for reducing cost of ammonia production lies in the manufacture of the pure hydrogen consumed in the process. At present the cost of hydrogen and its purification before it can be combined with nitrogen by the catalyzer represents about two-thirds the cost of the ammonia produced.

Three main roads for production of hydrogen are open to us: Electrolysis of aqueous solutions, decomposition of hydrocarbonaceous materials, and the reduction of water vapor directly or indirectly by carbon.

The electrolysis of aqueous solutions is a simple and well-established process already worked out nearly to its theoretically highest possible efficiency and produces hydrogen needing little further purification, but the consumption of electric energy is so great that it can only be considered where either (*a*) the main purpose of the electrolysis is to obtain some other valuable product, such as oxygen or caustic soda, and the hydrogen is thus a by-product, or (*b*) where electric power is exceedingly cheap. The total possibilities under (*a*) are small compared with the nitrogen industry and are widely scattered in small units. Those under (*b*) can only be considered as transitory for each individual case, because wherever electric power is developed in large quantity it immediately begins to build up its own market and its value inevitably and automatically rises.

Thus while the electrolytic process for hydrogen should be very useful in the present introductory stages of the synthetic ammonia process it must on the large scale eventually give place to purely chemical methods of preparation, which, though only closely competing with it at present, have intrinsically greater possibilities for improvement and thus for ultimate reduction of cost.

Through the chemical reactions of coal, coke, petroleum, or natural gas, either by themselves or with water vapor, crude hydrogen may

be prepared at a small fraction of its cost by the electrolytic method, but at present the cost of purification absorbs most of the saving over the electrolytic process. However, it is just in these purification processes that there appears to be the greatest chance for improvements, and thus for reducing the cost of the ultimate product, fertilizers. It is on this account that it is proposed in the coming year to center so large a proportion of the laboratory's efforts upon this problem of pure hydrogen production.

One of the methods already investigated was the cracking or decomposing of hydrocarbons, especially natural gas. Where large quantities of natural gas are going to waste, conversion of the gas into ammonia may be considered a conservation of our resources quite worth while, besides offering the possibility of cheap ammonia. The chief difficulty in this method lies not so much in the chemical and engineering aspect of the problem as in the uncertainty of the gas supply. If a plant could be assured of a continuous supply of natural gas for a number of years this might be a promising method for obtaining hydrogen and in turn ammonia.

The gases from the by-product coke ovens of this country contain many times the amount of free hydrogen required to fix all the nitrogen now consumed in fertilizers, but here again there is need for careful study of methods for separation and purification. This is another problem to which the laboratory is devoting its attention.

When hydrogen is made through the reduction of water vapor by coke in a gas producer, as was planned at Sheffield, the principal chemical problems are concerned with the conversion of carbon monoxide and steam to hydrogen and proper purification of the gas mixture before it can be used in the synthesis. These problems have been under study for some time by the laboratory, and already definite results have been obtained which will be of material assistance in operating such a plant as that at Sheffield.

During the past year a catalyst for converting carbon monoxide and steam into hydrogen was studied, which on a laboratory scale shows considerable promise. The efficiency of the catalyst for converting carbon monoxide and steam into hydrogen determines in part the nature of the final purification which can be employed. The removal of uncombined carbon monoxide by means of cuprous ammonium carbonate or formate solutions has been studied and the results have been published. The possibility of converting carbon monoxide into methane has also been investigated and catalysts suitable for this reaction have been studied.

### ARC PROCESS.

Concerning the electric-arc process for nitrogen fixation, this was the first to be commercially developed, due to its simplicity, but its excessive power consumption doomed it from the start in competition with the cyanamide and still more with the direct synthetic ammonia process. Another almost equally serious drawback to its peace-time competition is that it leads directly to nitric acid instead of ammonia, and this is less easily and cheaply converted into stable, dry fertilizer ingredients suited to our present methods of application. The possible importance of the arc process for military emergencies should, however, not be overlooked, as in this case a large amount of the

nitrogen is wanted in the form of nitric acid, and where power is available the simplicity of the arc furnaces makes the rapid installation of a large battery of them relatively easy. The cumbersome and expensive part of the arc installation has always been the large stone towers for absorbing in water the gases after leaving the furnaces. On this part of the process, however, there seems excellent opportunity for radical improvement, and during the past year this laboratory has made decided progress in this direction, especially on the use of solid adsorbents for the preliminary concentration of the active gases. The same procedure is also applicable in the manufacture of nitric acid by the oxidation of ammonia. This line of investigation is being actively continued and the results thus far obtained are being prepared for publication.

### ELECTRIC DISCHARGE IN GASES.

While there at present seems little hope of greatly reducing the consumption of electric power in the arc process proper, the study of electric discharge in nitrogen both by itself and mixed with other gases under a wide range of pressure and other conditions presents an extremely promising field for investigation which the laboratory is energetically developing. Aside from the possibility that out of such investigations may eventually come knowledge enabling us to more efficiently apply the electric current to the direct fixation of nitrogen, even greater importance is attached to this work because of the light it may throw upon the ultimate structure and chemical properties of the atoms and molecules here involved. In the present state of development of the art it would seem primarily through such knowledge as this that further fundamental improvements in any of the processes of nitrogen fixation can most confidently be looked for. This forms an extension of the work on ozone and active nitrogen mentioned in last year's report. Particularly significant is the progress made this past year in regard to the properties and behavior of active nitrogen which is formed when powerful electric discharges are passed through pure nitrogen at low pressure. Under these conditions the nitrogen after leaving the path of the discharge continues to glow for an appreciable time and reacts readily with many substances toward which ordinary nitrogen is quite inert.

In the arc process as commercially practiced, electrical, thermal, and photochemical phenomena are so closely intertwined as to be indistinguishable. The electrical investigations of the laboratory just referred to aim, among other things, at isolating and studying the electrical and photochemical parts of these phenomena.

### THERMAL PROCESSES.

On the other hand, the study of the purely thermal aspect of the phenomena occurring in the arc is also of great importance. This has found its practical expression, for instance, in the Haüser process, by which a certain amount of nitric acid was made by the Germans during the war. In this process the heat of explosion of a mixture of air and coal gas replaces that of the electric arc. If working under this principle it should prove possible to combine even a moderate recovery of both power and the oxides of nitrogen, it is easy to imagine important developments ultimately in this direction. The laboratory has as yet devoted very little detailed

study to this phase of the general problem, partly because its adequate study involves a very considerable excursion into the theory and practice of internal-combustion motors. The strengthening of our engineering division this year will greatly facilitate the handling of such problems.

### NITRIDES.

The fixation of nitrogen in the form of various nitrides has also occupied the attention of the laboratory this past year, but as yet nothing very definite has developed to indicate that this field holds out especial promise from the standpoint of self-contained fixation processes. The best immediate chances here would seem to lie in the possibility of combining nitrogen fixation with the preparation of some other valuable product; e. g., some of the modifications of the Serpek process, where the formation of aluminum nitride serves not only as a step toward fixing atmospheric nitrogen as ammonia, but also to prepare pure alumina from crude ore and possibly even admit of using as ore material not now considered available, such as bauxites running too high in iron for present processes.

### NITROGEN FIXATION BY ORGANISMS.

Nature's own most important channel for fixing atmospheric nitrogen and storing it up in our soils is undoubtedly the action of certain living organisms of which several species of bacteria are the best known. Much has been done both in the study of the best field conditions to favor these natural processes, as well as in attempts to cultivate specially active strains of the organisms and inoculate roots with them. This side of the problem falls more properly, however, within the province of the Bureau of Plant Industry and the Fixed Nitrogen Research Laboratory has therefore not concerned itself therewith.

There is, however, one aspect of the problem which directly interests this laboratory, and that is the question of the chemical mechanisms by which the organisms effect the fixation. These are of special significance, because aside from the combination with metallic lithium to form nitride, they appear to be the only positively established reactions of free nitrogen which proceed with measurable speed at ordinary temperatures. Could we discover just what class of compounds the bacteria use in thus operating on free nitrogen at these low temperatures, it might be the clue to a whole new chapter of nitrogen fixation on the industrial scale. Studies in this general direction are being undertaken by the laboratory with the cooperation of the Bureau of Plant Industry, but due to the intrinsic difficulty of the subject, the work is apt to go slowly even under the most favorable conditions.

## A COMPREHENSIVE SUMMARY.

Report on the Fixation and Utilization of Nitrogen, Nitrate Division, Ordnance Office, War Department, Document No. 2041, in cooperation with the Fixed Nitrogen Research Laboratory. (This report covers the subject in considerable detail and contains a chapter dealing with the accomplishments of the Fixed Nitrogen Research Laboratory from date of establishment up to 1922. This report can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 50 cents.)

## LIST OF ARTICLES FROM THE FIXED NITROGEN RESEARCH LABORATORY IN SCIENTIFIC AND TECHNICAL JOURNALS CHRONOLOGICALLY ARRANGED TO DATE.

Motion of Droplets and Particles in the Field of the Corona Discharge. R. C. Tolman and S. Karrer. Chem. and Met. No. 26, June 30, 1920.

The Entropy of Gases. R. C. Tolman. Jour. Amer. Chem. Soc., *42*, 6, June, 1920.

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Relativity Theories in Physics. R. C. Tolman. General Electric Review, June, 1920.

The Heat of Absorption of Vapors on Charcoal. A. B. Lamb and A. S. Coolidge. Jour. Amer. Chem. Soc., *42*, 6, June, 1920.

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The Thermal Decomposition of Gaseous Nitrogen Pentoxide. A Monomolecular Reaction. F. Daniels and E. H. Johnston. Jour. Amer. Chem. Soc., *43*, 1, Jan., 1921.

The Photochemical Decomposition of Nitrogen Pentoxide. F. Daniels and E. H. Johnston. Jour. Amer. Chem. Soc., *43*, 1, Jan., 1921.

Note on the Theory of Monomolecular Reactions. R. C. Tolman. Jour. Amer. Chem. Soc., *43*, 2, Feb., 1921.

The Principle of Similitude and the Entropy of Polyatomic Gases. R. C. Tolman. Jour. Amer. Chem. Soc., *43*, 4, Apr., 1921.

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Occurrence of Nitrides and Oxides in Boiler Tube Steel. A. E. White and J. S. Vanick. Transactions of American Society for Steel Treating, Vol. II, No. 4, 323, Jan., 1922.

Apparatus for Small Scale Testing of Ammonia Catalysts at Atmospheric Pressure. A. T. Larson, W. L. Newton, and W. Hawkins. Chem. and Met., vol. 26, March, 1922.

Apparatus for Moderate Scale Testing of Ammonia Catalysts at Variable Pressures. A. T. Larson and A. P. Brooks. Chem. and Met., vol. 26, March, 1922.

Apparatus for Moderate Scale Testing of Ammonia Catalysts at 100 Atmospheres Pressure. R. S. Tour. Chem. and Met., vol. 26, March, 1922.

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# REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ACCOUNTS AND DISBURSEMENTS,
*Washington, D. C., October 13, 1923.*

SIR: I am transmitting herewith the annual report of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1923.

Very respectfully,

A. ZAPPONE,
*Chief of Division.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## CHARACTER OF THE WORK.

As departmental disbursing clerk, the Chief of the Division of Accounts and Disbursements, in accordance with law and regulation, pays the accounts submitted to him by the various bureaus, divisions, and services of the department. Accounts are examined to ascertain that approvals are genuine, that computations, extensions, and additions are correct, and that there are appropriations out of which the items are legally payable. A detailed cashbook record of payments is maintained and controlling appropriation and disbursing ledgers are kept for the 800 or more appropriations, subappropriations and funds of the department for the current fiscal year and two prior fiscal years, comprising a complete double-entry system of ledgers and journal-cashbooks, with a subsidiary record of settlements made through the General Accounting Office. A separate double-entry ledger and journal-cashbook record is kept of the transactions under the disbursing clerk's "special account" of trust and special receipt funds.

By the use of a card-index register of the payments made to the individual creditors of the department for the current fiscal year and two prior fiscal years, involving over 200,000 separate accounts and necessitating 500,000 entries annually, duplicate payments are prevented and a ready reference to payees and payments is made available.

The disbursing clerk receives and deposits in the Treasury moneys accruing to the department from various sources, as well as cooperative trust funds handled through his "special account," and accounts for same to the departmental administrative officers and the General Accounting Office. Advances of public funds are made to employees

of the department for the payment of their expenses while traveling on official business.

The division supervises the placing of funds to the official credit of temporary special disbursing agents and other fiscal officers of the department, receives their quarterly disbursing accounts from the respective bureaus after these have completed their administrative examination, makes a record of the accounts and transmits them to the General Accounting Office. It also keeps the departmental record of amounts withheld from employees' salaries under the provisions of the retirement act of May 22, 1920; prepares the central record for classifying the expenditures of the department under the objects of expenditure prescribed by the Comptroller General in Bulletin No. 1 of May 11, 1922; maintains a record of liabilities and disbursements in connection with purchases of lands under the Weeks forestry law, and, under the direction of the Secretary and the Budget officer, compiles the annual estimates of appropriations. In addition to the regular financial statements, special and miscellaneous statements and reports are prepared from time to time as required.

## WORK OF THE YEAR.

### APPROPRIATIONS, EXPENDITURES, UNEXPENDED BALANCES, ETC.

To carry on the regular work of the Department of Agriculture, consisting of its research, extension, regulatory and service activities, and its campaigns for the control and eradication of animal and plant diseases and pests, during the fiscal year ended June 30, 1923, Congress appropriated or provided $41,158,727.21. In addition, appropriations and funds amounting to $48,110,890.02 were provided by Congress to be administered by and expended under the direction of the department for work other than its regular activities, such as Federal highway and forest road and trail construction, cooperative agricultural extension work through the State agricultural colleges under the Smith-Lever Act, research work by the State agricultural experiment stations under the Hatch and Adams Acts, and other special activities devolving upon the department by operation of law, making the total for the fiscal year 1923, for all purposes, $89,269,617.23. This sum includes $36,774,173 carried in the Agricultural appropriation act and $52,495,444.23 in supplemental, permanent annual, special and indefinite appropriations and funds, and allotments from other departments, as follows: Supplemental appropriations of $849,980 contained in various deficiency appropriation acts; the permanent annual appropriations of $3,000,000 for the enforcement of the meat inspection act and $4,580,000 for extension work in agriculture and home economics through the State agricultural colleges; $25,000,000 for the construction of Federal highways in cooperation with the States and $11,000,000 for road and trail building within or adjacent to the national forests; $3,232,863 for payment of the $240 bonus or increase of compensation to the employees of the department; $2,840,072.62 which became available from national forest receipts and Forest Service cooperative funds for cooperative work, road and trail construction, refundments of excess deposits, and payments to the States for the benefit of roads and schools; $66,711.21 in fees collected for the classi-

fication of cotton and used as a revolving fund to pay for the cost of this work; $1,388,194.40 collected from farmers to whom seed grain loans had been made in 1921 and 1922, not available for further disbursement but deposited in the Treasury to the credit of the appropriation; $500,000 allotted by the President from national defense act funds for fixed-nitrogen research by the department; $25,000 for the expenses of the National Forest Reservation Commission, and $12,623 in allotments transferred from other departments under the act of May 21, 1920, for work to be done at their request by the Department of Agriculture.

In addition to these appropriations made for the fiscal year 1923, unexpended balances of appropriations for prior years totaling $195,165,739.50 remained available for expenditure during this year. By far the largest portion of these balances consisted of $178,703,521.43 in Federal aid road construction funds and $6,408,586.52 in forest road and trail building appropriations, available until expended and almost fully obligated through cooperative road building agreements with States, counties, and communities. The remainder of the unexpended balances from prior years available for expenditure during the fiscal year 1923, consisted of $4,720,027.44 under the various appropriations in the Agricultural act for the fiscal year 1922, and $1,410,196.82 under other appropriations for that year; $963,317.01 remaining from appropriations provided by the Agricultural act for the fiscal year 1921, and $880,701.61 from other appropriations for that year, and $2,079,388.67 in unexpended balances of continuing appropriations available until expended.

The total amount available for expenditure during the fiscal year 1923, including these balances from prior years, was, therefore, $284,435,356.73.

During the year the disbursements by the disbursing clerk, fiscal agents, and temporary special disbursing agents of the department amounted to $127,137,345.71, of which $31,388,336.97 was disbursed from the appropriations provided by the agricultural act for the fiscal year 1923, $14,448,990.02 from the supplemental, permanent annual, special and indefinite appropriations and funds for that year and allotments from other departments, and $81,300,018.72 from the unexpended balances remaining available from annual and continuing appropriations for prior years.

At the close of the fiscal year, June 30, 1923, $157,298,011.02 remained unexpended. Of this sum, $5,385,836.03 represented unexpended balances of appropriations in the agricultural act for 1923, $38,046,454.21 unexpended balances of supplemental, permanent annual, special and indefinite appropriations, and funds and allotments from other departments for 1923, and $113,865,720.78 unexpended balances of annual and continuing appropriations for 1922 and prior years. On June 30, 1923, $1,702,859.80 of these balances was transferred to the surplus fund of the Treasury and $502.03 in allotments no longer available for expenditure was returned to the departments from which the allotments originated, leaving $155,594,649.19 to be carried forward as available for expenditure in the fiscal year 1924. The bulk of this amount consists of $132,101,768.71 in Federal-aid road building funds, and $11,279,523.79 in forest road and trail construction appropriations, almost fully obligated through cooperative road building agreements.

During the fiscal year 37 trust and special receipt funds were handled through the disbursing clerk's "special account." The balance in this account at the beginning of the year, July 1, 1922, was $326,365.36; the receipts during the year were $1,761,470.87; and the disbursements, transfers to the regular account, and refundments were $1,674,317.19; leaving a balance of $413,519.04 in the account on June 30, 1923. The transactions in this account required the issuance of 16,957 checks on the Treasurer of the United States.

In connection with the regular account of the disbursing clerk, his office examined and paid 204,282 vouchers and pay rolls during the year, requiring the issuance of 383,109 checks on the Treasurer of the United States. The fiscal agents of the Forest Service paid 122,638 additional vouchers and pay rolls and issued 213,819 checks on the Treasurer of the United States.

Of the checks issued by the disbursing clerk, 212 were lost in transit through the mails or by the payees, and were duplicated by his office after bonds of indemnity had been furnished by the payees as required by law and regulation.

The semimonthly payment of salaries of employees stationed in Washington involved the handling and disbursement of $7,383,436.54 in cash.

During the year 10,795 freight and other accounts were sent to the General Accounting Office for payment.

### PUBLIC MONEYS RECEIVED BY THE DEPARTMENT.

The department received during the fiscal year 1923, from the sources indicated, the following amounts, which were covered into the Treasury:

| | | |
|---|---|---|
| (*a*) Deposited to the credit of miscellaneous receipts fund: | | |
| 1. | Forest reserve fund, from sales of timber, grazing fees, and use of forest lands (after deducting from the gross receipts of $5,437,642.32 refundments of excess deposits amounting to $101,824.19 and the special fund of $528,569.06 to be used for forest road and trail building in 1924) | $4,807,249.07 |
| 2. | Forest Service cooperative fund (the receipts of $1,517,467.46 are shown below under special funds of the Forest Service). | |
| 3. | Civil-service retirement deductions | 2,055.39 |
| 4. | Sales of agricultural products, etc | 5,082.90 |
| 5. | Proceeds of sale of Government property | 142,255.20 |
| 6. | Reimbursement for Government property lost | 2,747.12 |
| 7. | Damages to Government property | 220.72 |
| 8. | Receipts from United States telegraph and telephone lines | 6,488.79 |
| 9. | Rent of public buildings, etc | 2,560.70 |
| 10. | Interest on seed-grain loans | 82,806.83 |
| 11. | Reimbursement for inspection of food products | 144,687.84 |
| 12. | Collections in appeals under grain standards act | 37,167.08 |
| 13. | Fees under United States warehouse act | 3,642.40 |
| 14. | Work done by Agricultural Department | 29,017.15 |
| 15. | Fumigation of cars and wagons | 55,372.00 |
| 16. | Surplus war materials | 19,002.78 |
| 17. | Center Market rentals | 124,244.32 |
| 18. | Center Market storage and other charges | 112,304.26 |
| | Total deposited to credit of miscellaneous receipts fund (exclusive of Forest Service funds shown immediately below) | 5,576,904.55 |

| | |
|---|---|
| (*b*) Deposited to the credit of miscellaneous receipts fund, but subsequently appropriated as special funds for use of the Forest Service: | |
| 1. Ten per cent of net receipts from sales of timber, grazing fees, and use of forest lands, appropriated as special fund for construction of forest roads and trails in 1924 | $528,569.06 |
| 2. Contributions to Forest Service cooperative fund, appropriated for cooperative work in forest investigations, road and trail building, etc | 1,517,467.46 |
| Total deposited to credit of miscellaneous receipts fund but subsequently appropriated for use of the Forest Service | 2,046,036.52 |
| (*c*) Deposited to the credit of appropriations for regular work of department: | |
| Bureau of Animal Industry— | |
| 1. Payments by packers for overtime services of meat-inspection employees | 269,460.52 |
| 2. Payments by Navy Department for inspection of meats and meat food products | 37,615.68 |
| Bureau of Agricultural Economics— | |
| 3. Reimbursement for cost of classifying cotton | 66,711.21 |
| Various bureaus— | |
| 4. Miscellaneous collections, including refunds on unused railroad tickets and scrip, recoveries and refundments on account of overpayments, etc | 28,315.90 |
| 5. Disallowances by General Accounting office in disbursing clerk's account | 485.27 |
| Total deposited to credit of appropriations for regular work of the department | 402,588.58 |
| (*d*) Deposited to the credit of other appropriations administered by the department: | |
| Bureau of Public Roads— | |
| 1. Reimbursement for cost to department of distributing surplus war materials to various States for use in road construction | 573,183.95 |
| Seed Grain Loan Committee— | |
| 2. Repayments by farmers of seed grain loans made to them during fiscal years 1921 and 1922 | 1,388,194.40 |
| Total deposited to the credit of other appropriations administered by the department | 1,961,378.35 |
| Total receipts during fiscal year 1923 | 9,986,908.00 |

## STATEMENT OF APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Fiscal years 1839 to 1920, inclusive.]

| Fiscal year. | Appropriations. | Disbursements. | Unexpended balances. | Fiscal year. | Appropriations. | Disbursements. | Unexpended balances. |
|---|---|---|---|---|---|---|---|
| 1839.. | $1,000.00 | $1,000.00 | ..... | 1880.. | $210,500.00 | $209,361.72 | $1,138.28 |
| 1840.. | ..... | ..... | ..... | 1881.. | 284,300.00 | 276,448.53 | 7,851.47 |
| 1841.. | ..... | ..... | ..... | 1882.. | 371,500.00 | 362,961.34 | 8,538.66 |
| 1842.. | 1,000.00 | 1,000.00 | ..... | 1883.. | 686,941.00 | 669,486.61 | 17,454.39 |
| 1843.. | ..... | ..... | ..... | 1884.. | 648,140.00 | 645,116.96 | 3,023.04 |
| 1844.. | 2,000.00 | 2,000.00 | ..... | 1885.. | 877,690.00 | 780,694.64 | 96,995.36 |
| 1845.. | 2,000.00 | 2,000.00 | ..... | 1886.. | 825,248.00 | 666,470.89 | 158,777.11 |
| 1846.. | 3,000.00 | 3,000.00 | ..... | 1887.. | 872,715.00 | 843,360.33 | 29,354.67 |
| 1847.. | 3,000.00 | 3,000.00 | ..... | 1888.. | 1,864,730.00 | 1,848,793.56 | 15,936.44 |
| 1848.. | 4,500.00 | 4,500.00 | ..... | 1889.. | 1,975,080.00 | 1,874,189.62 | 100,890.38 |
| 1849.. | 3,500.00 | 3,500.00 | ..... | 1890.. | 1,804,200.00 | 1,605,884.51 | 198,315.49 |
| 1850.. | 5,500.00 | 5,500.00 | ..... | 1891.. | 2,336,502.00 | 2,230,730.15 | 105,771.85 |
| 1851.. | 5,500.00 | 5,500.00 | ..... | 1892.. | 3,538,153.00 | 3,487,759.54 | 50,393.46 |
| 1852.. | 5,000.00 | 5,000.00 | ..... | 1893.. | 3,323,060.00 | 3,138,429.53 | 184,630.47 |
| 1853.. | 5,000.00 | 5,000.00 | ..... | 1894.. | 3,708,500.00 | 3,082,113.70 | 626,386.30 |
| 1854.. | 10,000.00 | 10,000.00 | ..... | 1895.. | 3,611,915.00 | 3,126,030.38 | 485,884.62 |
| 1855.. | 50,000.00 | 50,000.00 | ..... | 1896.. | 3,688,750.00 | 3,199,653.20 | 489,096.80 |
| 1856.. | 30,000.00 | 30,000.00 | ..... | 1897.. | 3,940,532.00 | 3,840,281.45 | 100,250.55 |
| 1857.. | 75,000.00 | 75,000.00 | ..... | 1898.. | 3,572,902.00 | 3,530,510.44 | 42,391.56 |
| 1858.. | 63,500.00 | 63,157.25 | $342.75 | 1899.. | 3,987,202.00 | 3,958,212.73 | 28,989.27 |
| 1859.. | 60,000.00 | 60,000.00 | ..... | 1900.. | 4,127,922.00 | 4,069,503.42 | 58,418.58 |
| 1860.. | 40,000.00 | 40,000.00 | ..... | 1901.. | 4,423,500.00 | 4,358,371.42 | 65,128.58 |
| 1861.. | 60,000.00 | 60,000.00 | ..... | 1902.. | 5,090,433.00 | 5,070,328.28 | 20,104.72 |
| 1862.. | 64,000.00 | 63,704.21 | 295.79 | 1903.. | 6,206,960.00 | 5,925,344.84 | 281,615.16 |
| 1863.. | 80,000.00 | 80,000.00 | ..... | 1904.. | 6,740,024.00 | 6,684,311.63 | 55,712.37 |
| 1864.. | 119,770.00 | 109,270.00 | 10,500.00 | 1905.. | 6,589,540.00 | 6,513,865.63 | 75,674.37 |
| 1865.. | 150,604.00 | 150,496.50 | 107.50 | 1906.. | 8,370,690.00 | 8,174,510.02 | 196,179.98 |
| 1866.. | 167,787.82 | 167,787.82 | ..... | 1907.. | 11,116,440.00 | 9,916,252.70 | 1,200,187.30 |
| 1867.. | 199,100.00 | 199,100.00 | ..... | 1908.. | 13,613,040.00 | 13,170,739.63 | 442,300.37 |
| 1868.. | 279,020.00 | 277,094.34 | 1,925.66 | 1909.. | 16,063,106.00 | 15,756,766.45 | 306,339.55 |
| 1869.. | 210,198.00 | 210,198.00 | ..... | 1910.. | 17,136,736.00 | 16,725,796.13 | 410,939.87 |
| 1870.. | 156,440.00 | 151,596.93 | 4,843.07 | 1911.. | 20,832,636.00 | 20,368,954.64 | 463,681.36 |
| 1871.. | 188,180.00 | 186,876.81 | 1,303.19 | 1912.. | 22,403,209.00 | 20,986,207.28 | 1,417,001.72 |
| 1872.. | 197,070.00 | 195,977.25 | 1,092.75 | 1913.. | 22,662,315.00 | 21,971,927.22 | 690,387.78 |
| 1873.. | 202,440.00 | 201,321.22 | 1,118.78 | 1914.. | 24,086,945.00 | 23,348,321.00 | 738,624.00 |
| 1874.. | 259,871.00 | 235,946.78 | 23,924.22 | 1915.. | 28,880,075.00 | 28,113,863.88 | 766,211.12 |
| 1875.. | 357,380.00 | 341,079.83 | 16,300.17 | 1916.. | 28,004,082.00 | 27,594,068.32 | 410,013.68 |
| 1876.. | 264,120.00 | 213,843.64 | 50,276.36 | 1917.. | 36,133,100.00 | 34,360,180.56 | 1,772,919.44 |
| 1877.. | 333,687.00 | 327,206.23 | 6,480.77 | 1918.. | 71,130,513.00 | 65,969,604.07 | 5,160,908.93 |
| 1878.. | 327,640.00 | 326,634.94 | 1,005.06 | 1919.. | 114,087,216.00 | 108,937,668.18 | 5,149,547.82 |
| 1879.. | 217,400.00 | 217,360.00 | 40.00 | 1920.. | 142,733,924.00 | 70,265,464.64 | [1] 72,468,459.36 |

[1] Does not include unexpended balances of annual and continuing appropriations from prior fiscal years of $124,248,854; total balance available for further disbursement in fiscal year 1921, $196,717,313.

## STATEMENT OF APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Fiscal years 1921 to 1923, inclusive.]

| Fiscal year. | Appropriations. | | | | Disbursements. | | | | Unexpended balances. | | | | Amounts turned into surplus fund at close of fiscal year and allotments from other departments returned for transfer to surplus fund. | Balance available for disbursement in next fiscal year. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Agricultural appropriation act. | Supplemental, permanent annual, special, and indefinite appropriations and funds, and allotments from other departments. | Unexpended balances of appropriations for prior fiscal years available for further disbursement. | Total available for disbursement. | Agricultural appropriation act. | Supplemental, permanent annual, special, and indefinite appropriations and funds, and allotments from other departments. | Appropriations for prior fiscal years. | Total disbursed during fiscal year. | Agricultural appropriation act. | Supplemental, permanent annual, special, and indefinite appropriations and funds, and allotments from other departments. | Appropriations for prior fiscal years. | Total unexpended balance at close of fiscal year. | | |
| 1921 | $31,712,784 | $120,461,189 | $196,717,313 | $348,891,286 | $26,234,726 | $15,854,738 | $76,475,969 | $118,565,433 | $5,478,058 | $104,606,451 | $120,241,344 | $230,325,853 | $5,188,462 | $225,137,391 |
| 1922 | 36,404,259 | 98,642,659 | 225,137,391 | 360,184,309 | 31,000,029 | 16,670,878 | 99,618,478 | 147,289,385 | 5,404,230 | 81,971,781 | 125,518,913 | 212,894,924 | 17,729,185 | 195,165,739 |
| 1923 | 36,774,173 | 52,495,444 | 195,165,739 | 284,435,356 | 31,388,337 | 14,448,990 | 81,300,018 | 127,137,345 | 5,385,836 | 38,046,454 | 113,865,721 | 157,298,011 | 1,703,362 | 155,594,649 |

# REPORT OF THE CHIEF OF THE DIVISION OF PUBLICATIONS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
*Washington, August 15, 1923.*

SIR: I have the honor to submit herewith a report on the work of the Division of Publications for the fiscal year ended June 30, 1923.

Respectfully,

EDWIN C. POWELL,
*Acting Assistant in Charge of Publications.*

Hon. H. C. WALLACE,
*Secretary of Agriculture.*

## SUMMARY.

A greater amount of printing was done or chargeable to the department than during the preceding year although less money was appropriated for printing and binding. A decision of the comptroller to the effect that all work sent to the Government Printing Office during the year would be charged against the appropriation of 1923, no matter in what year it was completed, reversed the conditions previously existing when only jobs which were completed and delivered were charged to the printing and binding appropriation. At the close of the fiscal year 1922 the estimates for uncompleted work at the Government Printing Office amounted to $175,343.72. Included in this was the 1921 Yearbook, and partial or full charges for the complete reports of field operations, Bureau of Soils, for the years 1917, 1918, 1919, and 1920.

The chief of the division, John L. Cobbs, jr., resigned April 30 to accept a position of private employment.

The staff of editors was reduced by the transfer of William F. Harding in September to the Bureau of Entomology and the death in June of Robert B. Handy, both of whom had been with the division for many years.

The office of motion pictures was transferred to the office of the director of extension in order that all extension activities might be coordinated.

There was an extremely large turnover—75 per cent— of the $960 per annum clerical grade. Much difficulty was experienced in obtaining eligibles to fill these low-salaried positions, and still greater difficulty in endeavoring to hold the employees obtained, due to higher salaries paid by other offices and bureaus. The Divisions of Publications has a higher percentage of $960 positions than any bureau of the department and the salaries of the clerical grades are $189.31 lower than the average of the department. Efficient work is thereby seriously hampered because of the unenviable position in which our employees stand in relation to those of the entire department. It is hoped that this condition may be remedied in the near future so that our employees may be paid at least as well as the average.

The work of the division and of the office of the Superintendent of Documents is unnecessarily increased by the growing practice of bureaus and divisions of ordering publications to be mailed direct by them. Inasmuch as the law requires that all publications be mailed by the Superintendent of Documents, steps have been taken to discourage the practice referred to.

*Expenditures from the regular fund for printing and binding, with the number of copies (arranged by classes of printing and by bureaus and offices), for the fiscal year ended June 30, 1923.*

[Quantities and costs are those billed by the Government Printing Office for deliveries made during the year.]

| Bureau. | Grand total. | | Total publications. | | Farmers' Bulletins. | | Department Bulletins.[1] | | Department Circulars. | | Secretary's and Miscellaneous Circulars. | | Reports, etc.[2] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. |
| Accounts | 248,323 | $1,670.25 | 520 | $56.31 | | | | | | | | | 500 | $38.88 |
| Animal Industry | 2,847,976 | 19,052.47 | 995,468 | 15,514.22 | 475,000 | $5,817.50 | 67,975 | $3,001.87 | 258,520 | $1,962.95 | | | 2,500 | 246.87 |
| Biological Survey | 1,325,353 | 17,023.58 | 509,566 | 15,074.16 | 410,000 | 9,015.04 | 49,500 | 2,890.11 | 17,500 | 997.65 | | | 4,000 | 1,514.64 |
| Chemistry | 1,312,948 | 12,520.89 | 466,347 | 9,506.94 | 30,000 | 575.56 | 50,000 | 2,479.45 | 52,000 | 639.15 | 15,000 | $272.87 | 2,500 | 147.04 |
| Entomology | 2,335,851 | 24,893.97 | 960,897 | 17,163.86 | 700,000 | 12,196.13 | 77,000 | 2,814.40 | 169,500 | 1,144.73 | | | 3,000 | 716.30 |
| Agricultural Economics | 8,900,225 | 57,272.10 | 1,074,817 | 31,036.61 | 600,000 | 9,663.04 | 132,500 | 6,405.65 | 79,500 | 1,316.30 | 36,500 | 1,103.35 | 11,500 | 262.43 |
| Federal Horticultural Board | 789,036 | 3,943.68 | 128,025 | 2,260.27 | | | | | | | | | 3,500 | 200.21 |
| Forest Service | 6,498,623 | 48,588.58 | 616,306 | 18,831.05 | 60,000 | 748.50 | 97,500 | 6,992.05 | 124,500 | 2,932.65 | 64,000 | 2,024.94 | 12,000 | 543.43 |
| Insecticide and Fungicide Board | 149,953 | 1,113.12 | 30,573 | 687.48 | | | | | | | | | 2,500 | 32.40 |
| Journal of Agricultural Research | 61,003 | 19,737.93 | 61,000 | 19,723.58 | | | | | | | | | | |
| Library | 548,715 | 13,161.81 | 2,755 | 1,551.29 | | | | | | | | | | |
| Plant Industry | 4,402,503 | 56,340.95 | 1,914,629 | 47,022.89 | 744,450 | 13,331.45 | 304,324 | 16,874.96 | 2,000 | 1,448.51 | | | 750 | 91.04 |
| Public Roads | 984,084 | 7,733.81 | 179,042 | 5,387.69 | 120,000 | 2,003.93 | 28,425 | 1,730.81 | 449,500 | 4,613.12 | | | 3,500 | 136.30 |
| Publications | 29,732,515 | 334,211.69 | 28,037,219 | 332,426.70 | 19,526,255 | 178,480.37 | | | | | 5,000 | 82.47 | 1,500 | 247.90 |
| Secretary's office | 2,198,531 | 12,331.41 | 106,616 | 5,703.54 | | | | | 15,000 | 157.85 | | | 2,000 | 113.34 |
| Soils | 221,364 | 82,002.09 | 87,231 | 81,589.52 | | | | | | | 15,000 | 264.13 | 4,000 | 91.79 |
| States Relations Service | 1,309,703 | 34,504.95 | 666,001 | 30,415.09 | 188,400 | 2,721.62 | 13,000 | 817.83 | 189,500 | 3,952.63 | | | 500 | 46.10 |
| Weather Bureau | 14,021,718 | 44,736.47 | 150,662 | 30,719.59 | | | 8,000 | 112.89 | | | | | 87,800 | 5,765.60 |
| Total | 77,888,454 | 790,839.75 | 35,987,614 | 664,663.79 | 22,848,105 | 234,553.14 | 828,224 | 44,120.02 | 1,357,520 | 19,164.94 | 135,500 | 3,747.76 | 3,750 | 11,556.63 |
| | | | | | | | | | | | | | 145,800 | 21,750.90 |

[1] Includes one statistical bulletin of 4,500 copies amounting to $391.87.

[2] Annual reports of the chiefs of bureaus and of the agricultural experiment stations in Alaska, Guam, Hawaii, Porto Rico, and the Virgin Islands.

| Bureau. | Periodicals. | | Congressional publications.[3] | | Compilation of laws, manuals, fiscal regulations, etc. | | Separates and unnumbered pamphlets. | | Administrative circulars, orders, decisions, notices, etc. | | Forms, letters, and other administrative printing. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. | Copies. | Cost. |
| Accounts | | | 16 | $15.68 | | | | | 4 | $1.75 | 247,803 | $1,613.94 |
| Animal Industry | | | 1,099 | 59.06 | | | 56,000 | $2,513.26 | 134,374 | 1,912.71 | 1,852,508 | 3,538.25 |
| Biological Survey | | | 22 | 15.69 | | | 6,950 | 453.45 | 21,594 | 187.58 | 815,787 | 1,949.42 |
| Chemistry | | | 22 | 25.98 | | | 1,310 | 188.46 | 315,515 | 5,178.43 | 846,601 | 3,013.95 |
| Entomology | | | 41 | 20.00 | | | 11,300 | 254.80 | 56 | 17.50 | 1,374,954 | 7,730.11 |
| Agricultural Economics | | | 314 | 72.19 | | | 163,200 | 10,669.91 | 51,303 | 1,543.74 | 7,825,408 | 26,235.49 |
| Federal Horticultural Board | | | 9 | 10.84 | | | 5,000 | 25.08 | 119,516 | 2,024.14 | 661,011 | 1,683.41 |
| Forest Service | | | 1,031 | 37.20 | 725 | $315.13 | 219,900 | 4,331.61 | 36,650 | 905.54 | 5,882,317 | 29,757.53 |
| Insecticide and Fungicide Board | | | 9 | 10.84 | | | | | 28,004 | 644.24 | 119,440 | 425.64 |
| Journal of Agricultural Research | 60,000 | $19,664.57 | | | | | 1,000 | 59.01 | | | 3 | 14.35 |
| Library | | | 5 | 11.74 | | | | | | | 545,960 | 11,610.52 |
| Plant Industry | | | 113 | 55.06 | | | 403,048 | 11,866.61 | 9,694 | 145.39 | 2,487,874 | 9,318.06 |
| Public Roads | | | 1,052 | 1,036.91 | | | 20,000 | 230.76 | 3,065 | 54.91 | 805,042 | 2,346.12 |
| Publications | 7,252,200 | 114,572.09 | 42,889 | 35,019.68 | | | 1,200,512 | 3,348.03 | 4,363 | 735.34 | 1,695,326 | 1,784.99 |
| Secretary's office | | | 18,015 | 2,027.65 | 14,500 | 2,606.59 | 54,500 | 613.44 | 601 | 99.94 | 2,091,915 | 6,627.87 |
| Soils | | | 72,013 | 80,640.33 | | | 1,700 | 70.27 | 18 | 7.99 | 134,133 | 419.57 |
| States Relations Service | 180,050 | 15,869.48 | 47 | 24.61 | | | 1,050 | 113.70 | 11,154 | 1,855.16 | 643,702 | 4,089.86 |
| Weather Bureau | 20,850 | 8,763.33 | 19 | 19.08 | | | 119,475 | 9,575.99 | 6,568 | 804.56 | 13,871,056 | 14,016.88 |
| Total | 7,513,100 | 158,869.47 | 136,716 | 119,102.54 | 15,225 | 2,921.72 | 2,264,945 | 44,314.38 | 742,479 | 16,118.92 | 41,900,840 | 126,175.96 |

[3] Includes Yearbook; Soil Survey reports; Annual reports of Department of Agriculture (bound volume); reports of Secretary of Agriculture; press copies and summary of same; a few copies each of the Congressional Directory, Congressional Record, Book of Estimates, Alternate Budget, and certain acts, resolutions, and reports of Congress of interest to the department purchased on printing requisition; and composition and electrotyping of reports made to Congress but not printed for the department.

## NEW PUBLICATIONS.

*New publications issued during the year ended June 30, 1923.*

| | |
|---|---|
| Department Bulletins | 107 |
| Department Circulars | 59 |
| Soil Surveys | 41 |
| Yearbook Separates | 12 |
| Journal of Agricultural Research separates | 50 |
| Secretary and Miscellaneous Circulars | 8 |
| Service and regulatory announcements | 47 |
| Total | 324 |
| Reprints | 94 |
| Total | 418 |
| Farmers' Bulletins, new | 62 |
| Farmers' Bulletins, reprints | 557 |
| Total | 1,037 |
| Number of orders of job printing [1] | 2,075 |

*New Farmers' Bulletins issued during the year ended June 30, 1923.*

No.
1216. Beekeeping in the Buckwheat Regions.
1222. Beekeeping in the Tulip Tree Regions.
1236. Corn and Its Uses as Food.
1245. Farmers' Telephone Companies: Organization, Financing and Management.
1254. Important Cultivated Grasses.
1256. Slash Pine.
1263. Breeds of Swine.
1264. Farm Manufacture of Unfermented Grape Juice.
1265. Business Methods of Marketing Hay.
1268. Sheep Killing Dogs.
1269. Celery Growing.
1270. The More Important Apple Insects.
1271. Farm Land Available for Settlement.
1272. Renting Dairy Farms.
1273. The Stock-poisoning Death Camas.
1274. Uses of Rural Community Buildings.
1275. Weevils in Beans and Peas.
1276. The Velvet Bean.
1277. Diseases of Watermelons.
1278. Tractors on Southern Farms.
1279. Plain Concrete for Farm Use.
1280. The Hard Red Winter Wheats.
1281. The Hard Red Spring Wheats.
1282. Nicotine Dust for Control of Truck Crop Insects.
1283. How to Grow Alfalfa.
1284. Apple-Orchard Renovation.
1285. Lime-Sulphur Concentrates: Preparation, Uses and Designs for Plants.
1286. The Red-necked Raspberry Cane-borer.
1287. Foreign Material in Spring Wheat.
1288. Game Laws for 1922.
1290. The Bulk Handling of Grain.
1292. Organization and Management of Cooperative Livestock Shipping Associations.
1293. Laws Relating to Fur-bearing Animals, 1922.
1294. The European Corn Borer and Its Control.
1291. The Preparation of Fresh Tomatoes for Market.
1295. What Tractors and Horses do in Corn-Belt Farms.
1296. Changes Effected by Tractors on Corn-Belt Farms.
1297. Cost of Using Tractors on Corn-Belt Farms.
1298. Cost of Using Horses on Corn-Belt Farms.
1299. Shall I Buy a Tractor.
1300. Choosing a Tractor.

[1] Number ordered, irrespective of when received. Includes "carryovers" from 1922.

No.
1301. The Common White Wheats.
1302. How to Get Rid of Rats.
1303. The Club Wheats.
1304. The Durham Wheats.
1305. The Soft Red Winter Wheats.
1306. Insect Enemies of Chrysanthemums.
1307. Quack Grass.
1308. Cowpeas: Marketing the Seed Crop.
1309. Control of the Common Mealybug on Citrus in California.
1310. The Corn Earworm: Its Ravages on Field Corn and Suggestions for Control.
1312. Tree Planting in the Great Plains Region.
1313. Good Proportions in the Diet.
1314. Motor Trucks on Corn-Belt Farms.
1315. Cleaning Milking Machines.
1316. Marketing the Early-Potato Crop.
1318. Greenhouse Construction and Heating.
1319. Cotton-Dusting Machinery.
1320. The Production of Cucumbers in Greenhouses.
1322. The Striped Cucumber Beetle and How to Control It.
1327. Canaries: Their Care and Management.
1332. Seed Potatoes and How to Produce Them.

## FIELD PRINTING DONE ON CONTRACT BY PRINTERS OUTSIDE THE DISTRICT OF COLUMBIA AS OF AUGUST 1, 1923.

In addition to the printing done for the department at the Government Printing Office, a small quantity of emergency work was done by commercial printers at various points outside the District of Columbia. The amounts, by bureaus, were as follows:

| | |
|---|---|
| Bureau of Animal Industry | $19.78 |
| Bureau of Agricultural Economics | 140.90 |
| Bureau of Chemistry | 12.85 |
| Bureau of Entomology | 32.00 |
| Forest Service | 209.00 |
| Bureau of Plant Industry | 115.63 |
| Bureau of Public Roads | 35.70 |
| Secretary's office | 312.75 |
| Bureau of Soils | 9.50 |
| States Relations Service | 100.00 |
| Total | 988.11 |

## PRINTING DONE AT THE GOVERNMENT PRINTING OFFICE BUT CHARGED TO SPECIAL FUNDS OF BUREAUS AS OF AUGUST 1, 1923.

| | |
|---|---|
| Bureau of Animal Industry | $25,588.25 |
| Bureau of Agricultural Economics | 6,969.65 |
| Fixed Nitrogen Research Laboratory | 269.94 |
| Packers and Stockyards Administration | 322.12 |
| Bureau of Public Roads | 2,786.91 |
| States Relations Service | 4,008.69 |
| Total | 39,945.56 |

## PAPERS APPROVED FOR PUBLICATION IN OUTSIDE JOURNALS.

In addition to the material published by the department, articles were prepared by members of the department for publication in trade, scientific, and popular periodicals. The administrative regulations of the department formerly provided that these articles be approved by the Assistant Secretary and this review has been delegated to the editorial section of this division in order to be sure that

they conform to department policy, but such regulations were changed during the year and only a portion of the papers prepared for publication in outside periodicals were read in this division.

### EDITORIAL WORK.

Although the editorial section was hampered by the transfer of one editor to a higher-salaried position in another bureau and the death of another, there were 394 manuscripts besides the Yearbook prepared for publication and sent to the Government Printing Office during the year as against 384 during the preceding year. The handling of the Yearbook is in itself a large job which requires the most painstaking editing and arrangement. Not only was it larger in size than in many years but, due to the cordial cooperation of the Public Printer, it was printed, bound, and delivered in record time—10 weeks from the date the last copy was sent to the Printing Office.

The Journal of Agricultural Research resumed publication January 1, 1923.

### INDEXING WORK.

The current work of indexing has been kept well up to the high standard reached last year and for the first time a large amount of indexing which will not be printed has been done. The production of indexes for the Farmers' Bulletins and Department Bulletins in volumes of 25 numbers each has been interrupted and to an extent delayed by work on the cumulated index for the Yearbooks, 1916 to 1920, inclusive. This index is now completed and ready for the printer. It is believed to show some notable improvement over previous issues in the same series. The card index made up of cards from the indexing section and kept in the library of the department represents the accumulations of 18 years. It has never had a complete revision and its usefulness is impaired for lack of it. A thorough revision, combining cards that are alike, rejecting cards now obsolete, and making a more perfect alphabetic arrangement would be the work of a trained indexer, and would put the collection in condition to be used much more helpfully. With this done a renewed effort to bring the index into general use would be undertaken with spirit.

The indexes made and printed include yearbooks; annual reports; watch force; Weather, Crops, and Markets; Official Record; Farmers' Bulletins 1201 to 1225, inclusive; Department Bulletins 876 to 900, 976 to 1000, and 1026 to 1050, inclusive. An index was made to the Crop Reporter and the Crop Report, two names for a periodical practically continuous, but it has not been printed.

The total number of pages indexed was 28,350, and of index cards written, 53,472. The principal items are as follows:

Farmers' Bulletins: Pages, 1,614; cards, 2,166.
Department Bulletins: Pages, 4,607; cards, 4,259.
Department Circulars: Pages 1,035; cards, 1,530.
Weather, Crops, and Markets: Pages, 1,244; cards, 5,833.
Official Record: Pages, 416; cards, 6,842.
Press notices: Pages, 1,354; cards, 1,695.
Inventory of Seeds and Plants Imported: Pages, 548; cards, 1,293.
Soil Surveys: Pages, 1,405; cards, 618.
Experiment Stations Record: Pages, 1,418; cards, 226.
Congressional Record: Pages, 2,935; cards, 4,481.

## DISTRIBUTION.

A total of 30,679,941 publications, including periodicals, distributed by the department during the fiscal year 1923 is nearly 13 per cent less than during the preceeding year. Publications are broadly divided into two classes, namely, miscellaneous and Farmers' Bulletins. Miscellaneous publications are all those other than Farmers' Bulletins, and include Department Bulletins, circulars, and the regular serial publications. The number of miscellaneous publications distributed was 17,306,375, and the number of Farmers' Bulletins was 13,373,566.

During the year 30,509,273 publications were received, which, together with the total number on hand July 1, 1922, made 41,340,362 available for distribution, which leaves a balance on hand of 10,660,421 publications. The miscellaneous publications were distributed largely in accordance with the scheme for distribution prepared in advance, and to miscellaneous applicants by order of the issuing bureaus.

The following table shows the distribution of the miscellaneous publications of the different bureaus:

| | |
|---|---|
| Office of the Secretary | 140,843 |
| Insecticide and Fungicide Board | 38,095 |
| Federal Horticultural Board | 99,741 |
| Division of Accounts | 500 |
| Weather Bureau | 3,550 |
| Office of the Solicitor | 2,770 |
| Bureau of Animal Industry | 1,091,922 |
| Bureau of Biological Survey | 71,751 |
| Bureau of Chemistry | 515,566 |
| Bureau of Entomology | 136,086 |
| States Relations Service | 421,272 |
| Forest Service | 286,606 |
| Library | 2,432 |
| Bureau of Plant Industry | 702,129 |
| Division of Publications | 7,239,336 |
| Bureau of Public Roads | 34,359 |
| Bureau of Soils | 27,165 |
| Bureau of Agricultural Economics | 6,489,733 |
| Packers and Stockyards Administration | 1,000 |
| Fixed Nitrogen Research Laboratory | 797 |
| Office of Exhibits | 722 |
| Total | 17,306,375 |

The demand for information and for publications of this department from miscellaneous applicants amounted to 620,000 communications. During the rush season as many as 5,000 are received daily. In order to render prompt and efficient service in handling these requests, it was necessary to secure some temporary clerical help. More than $3,000 was received from persons desiring to purchase publications, the major portion of which was sent to the office of the Superintendent of Documents, while a small portion was sent to other departments authorized to sell their publications. Some of the money received was returned to the original senders where the publications requested were available for free distribution or were no longer carried in the sale stock at the office of the Superintendent of Documents.

A phase of work which is growing in importance is the distribution of publications to foreign countries. Pursuant to Memorandum 397,

Office of the Secretary, dated October 9, 1922, the method of handling this work was changed from the monthly allotment of authorization plan and the restrictions affecting the bureaus in mailing publications to foreign countries removed. Under the present plan, a bureau may send as many publications to a foreign address as is deemed proper. Postage for mailing is furnished by the chief clerk, and the appropriation for that office is reimbursed by the bureau. Below is given a summary of the foreign mail work for the year; 3,472 orders were received.

| | Number. | Weight. | Postage. |
|---|---|---|---|
| | | *Lbs. oz.* | |
| Packages requiring postage | 122,087 | 29,457 2 | $2,356.57 |
| Packages sent through the international exchange | 10,712 | 6,205 4 | 310.23 |
| Total number of packages sent | 132,799 | 35,622 6 | 2,666.80 |

Closely associated with the work of the distribution of publications is the work of receiving and distributing the job work printed at the Government Printing Office for the department. Some idea of the magnitude of this work may be had from the accompanying summary of the receiving and shipping clerk:

| | |
|---|---|
| Deliveries received from the Government Printing Office | 4,377 |
| Packages of publications received from the Government Printing Office | 7,073 |
| Copies of publications received from the Government Printing Office | 2,792,996 |
| Packages of job work received from the Government Printing Office | 25,738 |
| Copies of job work received from the Government Printing Office | 38,056,592 |
| Bags sent from the Division of Publications | 3,590 |
| Packages sent from the Division of Publications | 46,440 |

## MAILING LIST WORK.

The work of maintaining mailing lists for the department is one of the most important phases of the work of distribution. Of such importance is this work that the Congressional Joint Committee on Printing has deemed it necessary to incorporate in its regulations a paragraph pertaining to it.

Pursuant to Regulations No. 12, paragraph 10, of that committee, all departments are requested to revise their mailing lists at least once every six months. During the last fiscal year the mailing-list unit of this division instituted steps to revise all mailing lists coming within the provision above mentioned. As a result of this activity, questionnaire post cards were sent to 128,101 addresses, resulting in a net reduction of 71,222. Despite this reduction by revision, however, there is an apparent increase of 16,480 in the lists maintained in the office of the Superintendent of Documents, which totaled 267,760 addresses on June 30, 1922, and 284,240 on June 30, 1923. This increase is due to the addition of 30,000 names to the livestock inquiry list of the division of crop and livestock estimates of the Bureau of Agricultural Economics. In addition to the lists at the Government Printing Office, 588 are maintained in the addressing, duplicating, and mailing section of this division, the aggregate addresses of which total 260,255, which is an increase of 47,942 over the number of stencils filed under similar date last year. The total number of addresses on all mailing lists of which we have a record is 544,495. These addresses go to make up 783 individual mailing

lists, 195 of which are located at the Government Printing Office and 588 in the addressing, duplicating, and mailing section of this division.

A summary of the various operations included in the mailing-list work is given below:

| | |
|---|---|
| Communications received | 89,000 |
| Addresses added | 57,379 |
| Addresses dropped | 27,089 |
| Addresses alphabetized | 160,936 |
| Addresses forwarded to the Government Printing Office | 135,480 |
| Addresses forwarded to the addressing, duplicating, and mailing section | 51,000 |

By devising and adhering to new clerical assignment plans, the work of the office has been greatly expedited, individual responsibility placed, and the new file kept up to date by purging it of "dead" material and filing of current work by means of the new "double-check" file system whereby chances of mistakes and error are reduced to a minimum.

The compilation and issuance of the mailing-list key book, a comprehensive record of all mailing lists of the department, it is thought has greatly assisted bureau employees handling mailing lists, employees making up schemes of distribution, mailing-list file clerks, and employees who handle the lists (i. e., stencils), by furnishing a ready-reference record to the numerous questions arising in connection with list work and has also proved valuable in assisting the distribution offices in making intelligent distributions, thereby preventing waste in publications distributed.

## ILLUSTRATIONS WORK.

After a year's work in the building at 220 Linworth Place, we find our quarters better fitted to our needs than our old location in the Bieber Building.

The drafting work has been in arrears for the entire year. On two occasions draftsmen have been detailed to the Bureau of Agricultural Economics to assist in the preparation of graphical work for the Yearbook. We need the services of an expert commercial artist, but good men will not take the civil-service examinations at the low salaries. We should be in a position to take up illustrative work on publications immediately they are ready for the printer. It has been necessary to refuse all drafting work which was not intended for publication except when such drafting was in combination with photographic work. The following statement shows the number of drawings made for the various bureaus of the department:

| | |
|---|---|
| Bureau of Agricultural Economics | 167 |
| Bureau of Animal Industry | 537 |
| Bureau of Biological Survey | 106 |
| Bureau of Chemistry | 76 |
| Bureau of Entomology | 91 |
| Federal Horticultural Board | 7 |
| Forest Service | 263 |
| Bureau of Plant Industry | 635 |
| Division of Publications | 532 |
| Bureau of Public Roads | 25 |
| Office of the Secretary | 407 |
| Bureau of Soils | 33 |
| States Relations Service | 41 |
| Weather Bureau | 7 |
| Total | 2,927 |

The output of the photographic laboratory compares favorably with last year's work. The studio has been removed from the top floor of the Administration Building and placed in the Linworth Place Building, which brings the office in close touch with the studio and makes it much more convenient for the bureaus to procure their work. New enlarging equipment has been installed in the old studio, but the location is so remote from the office it is difficult to give the work proper supervision. The rooms are not suited to enlarging work and we are in constant fear of flooding the offices below. An ideal location would be in the basement of the building at 220 Linworth Place, which is now used for storing cotton.

The proceeds from the sale of photographs from department negatives amounted to $1,619.81, which was turned over to the disbursing office to be covered into the Treasury. In the past it has been customary to make a nominal charge for photographs furnished writers and educational institutions. However, through a recent decision of the Assistant Secretary it has been decided to furnish a reasonable number of photographs to such applicants without cost. The following summary shows the output of the year's photographic work:

| | |
|---|---|
| Prints | 121,192 |
| Negatives | 9,474 |
| Negatives developed | 4,856 |
| Lantern slides | 13,325 |
| Lantern slides bound | 10,737 |
| Lantern slides colored | 482 |
| Bromides | 6,769 |
| Bromides and maps mounted | 5,087 |
| Bromides colored | 118 |
| Solar bromides | 725 |
| Photostats | 15,034 |
| Transparencies | 142 |
| Prints mounted | 5,759 |
| Total | 193,700 |

Since the Public Printer holds that all cuts appearing in the publications of the department are the property of the Printing Office, and is sustained in this opinion by the solicitor of the department, approximately 40,000 cuts and all the files pertaining to them were turned over to the Printing Office.

### ADDRESSING, DUPLICATING, AND MAILING WORK.

The consolidation of the addressing and duplicating work of the department, which was accomplished early in the preceding fiscal year, has resulted in more prompt and efficient work and a higher standard of quality. There has been a notable increase in work which the bureaus and offices have asked this division to do. There was an increase of 44.5 per cent in the number of mimeograph jobs and 71.5 per cent in the work performed; 19.5 per cent in the number of multigraph jobs and 25.5 per cent in the work performed, due, in each case, to the larger number of pages per job. Other lines of work show corresponding increases over that performed in 1922. There is no indication of any decrease; on the other hand, there is every probability of a sure and steady growth. In order to keep the work current it has been necessary this summer to put in considerable overtime by working nights, a practice that is not conducive

to good morale, because of the impossibility of paying employees for overtime work. Because of these conditions it will be necessary to make provision to employ more operatives. As this division has no lump-sum fund with which to supply these operatives it will be necessary that some other arrangement be made to take care of the increased work which this section is being called upon to do. A summary of the work follows:

| Bureau. | Multigraph work. | | | Mimeograph work. | | |
|---|---|---|---|---|---|---|
| | Jobs. | Copies. | Pages. | Jobs. | Copies. | Pages. |
| Division of Accounts | 30 | 27,400 | 27,900 | 13 | 4,080 | 13,045 |
| Bureau of Agricultural Economics | 559 | 4,950,960 | 5,583,755 | 2,708 | 3,998,574 | 10,940,739 |
| Bureau of Animal Industry | 42 | 85,614 | 107,264 | 641 | 449,236 | 991,908 |
| Bureau of Biological Survey | 102 | 134,755 | 150,580 | 158 | 107,430 | 288,400 |
| Bureau of Chemistry | 139 | 191,191 | 282,265 | 405 | 124,755 | 716,618 |
| Bureau of Entomology | 51 | 54,850 | 61,350 | 121 | 64,293 | 341,001 |
| Federal Horticultural Board | 79 | 318,700 | 473,550 | 140 | 190,260 | 418,189 |
| Forest Service | 42 | 469,280 | 532,860 | 137 | 153,648 | 725,280 |
| Grain Futures | 4 | 20,300 | 30,200 | 9 | 4,894 | 21,100 |
| Seed Loan Office | 11 | 319,000 | 319,000 | | | |
| Insecticide and Fungicide Board | 17 | 20,500 | 25,000 | 21 | 6,508 | 8,058 |
| Library | 25 | 20,350 | 20,850 | 61 | 1,676 | 2,200 |
| Fixed Nitrogen Research Laboratory | 7 | 32,000 | 34,000 | 1 | 75 | 125 |
| Packers and Stockyards Administration | 46 | 105,561 | 141,271 | 177 | 58,561 | 283,946 |
| Bureau of Plant Industry | 248 | 1,188,383 | 2,347,303 | 552 | 314,833 | 1,032,829 |
| Division of Publications | 168 | 2,293,575 | 2,354,795 | 48 | 35,855 | 116,680 |
| Bureau of Public Roads | 35 | 122,925 | 152,100 | 57 | 85,177 | 147,791 |
| Office of the Secretary | 202 | 686,164 | 866,246 | 829 | 487,501 | 1,417,279 |
| Bureau of Soils | 11 | 13,600 | 14,600 | 65 | 16,022 | 38,867 |
| States Relations Service | 64 | 210,209 | 329,659 | 253 | 223,009 | 1,768,668 |
| Weather Bureau | | | | 14 | 14,911 | 26,591 |
| Total | 1,882 | 11,265,317 | 13,854,548 | 6,410 | 6,341,298 | 19,299,314 |

*Miscellaneous work.*

| | |
|---|---|
| Envelopes and franks addressed | 5,070,979 |
| Dermatype stencils cut | 17,382 |
| Stencils memeoscoped | 1,016 |
| Number of sheets perforated | 73,911 |
| Plates embossed | 74,159 |
| Plates corrected | 7,530 |
| Plates added | 26,555 |
| Plates removed | 13,533 |
| Pages assembled | 12,259,674 |
| Pages folded | 7,860,326 |
| Copies stapled | 1,153,291 |
| Envelopes sealed | 2,779,569 |
| Items inserted | 5,561,814 |
| Pads made | 73,391 |
| Sheets of paper cut | 10,489,457 |
| Round holes cut | 1,929,024 |
| Holes punched | 30,443 |
| Metal tags embossed | 637 |

*Miscellaneous distribution.*

| | Copies. |
|---|---|
| 3,518 Farmers' Bulletin orders amounting to | 122,757 |
| 11,048 miscellaneous orders amounting to | 4,574,139 |

## WORK OF THE OPERATIONS SECTION.

There were 945 telephone calls to the information desk and 3,827 visitors seeking information and bulletins on various agricultural subjects. From outside sources were received 1,534 requests for

publications to be sent to addresses furnished. The total distribution from this section was 24,105 Farmers' Bulletins and 5,745 miscellaneous publications.

After a thorough study of existing conditions in the section of illustrations a system of cost accounting was developed and is now in the process of installation.

### CONSOLIDATION OF STOCK OF PUBLICATIONS.

For some time past it has been the practice to carry a stock of 25 of each publication in the addressing, duplicating, and mailing section. This was considered necessary under the schemes of distribution which were then in effect. By a careful review of these schemes of distribution it developed that the carrying of this duplicate stock in the addressing, duplicating, and mailing section could be eliminated and at the same time improve the service. This stock was consolidated with the stock already carried by the distribution section at 215 Thirteenth Street SW., resulting in a saving of time and speeding up of department work.

Prior to the consolidation the storage space in the basement of 215 Thirteenth Street was entirely utilized and the matter of obtaining increased space was under consideration, but by systematic reduction of the bulk stock, resulting from facts developed by a very careful inventory, it is now possible to not only carry the necessary stock in the present space but to have space reserved for the arrival of new publications. While this reduction of bulk stock and consequent saving of space has not resulted in any monetary saving, yet had it not been done it was only a question of time when it would have been necessary to obtain additional space.

### IMPROVEMENT OF PERSONNEL.

While there has been no reduction in personnel of the division, yet by shifting the various employees to where their services were most needed it has been possible to keep the work practically up to date whereas formerly the work was at certain periods of the year from four to six weeks behind. This has enabled us to make a saving this year of approximately $650 in money available for employment of emergency assistance. A rearrangement of the personnel will enable us to drop 12 positions, totaling $9,000 annually, July 1, 1923, in addition to the employees in the sections of Motion Pictures and Exhibits who were transferred to the Extension Service roll.

# REPORT OF THE OFFICE OF MOTION PICTURES.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF MOTION PICTURES,
*Washington, D. C., September 29, 1923.*

SIR: I have the honor to transmit herewith a report of the work of the Office of Motion Pictures for the fiscal year ended June 30, 1923.

Respectfully,

FRED W. PERKINS,
*In charge Office of Motion Pictures.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

The past year has been notable in the motion-picture work of the Department of Agriculture. Just 10 years after the department had begun to experiment in this field came two developments that indicate the definite adoption of the "silver screen" as an important instrument in our extension, educational, and publicity work. The first development was the occupancy by the motion-picture office and laboratory of a modern fireproof building which gives immeasurably better facilities for this work than the old quarters in the basement of an office building. The second development was one of the steps in the general reorganization of the extension and publications work of the department and resulted on July 1, 1923, in giving the film work definite status as the Office of Motion Pictures, a separate unit reporting to the Director of Extension Work. This changed status should result in the films becoming more representative of the work of the department, as well as in the production and distribution of films more sensitive to the needs of the extension and field workers who have direct contact with the general public.

Other definite accomplishments in the motion-picture work during the year included the following:

Completion of 28 new motion pictures.
Revision of 43 old films.
Beginning of editorial or production work, or both, on 25 new films.
Addition of 229 new prints, totaling 323 reels, to the department's stock.
Circulation of department films through extension workers and others to a partially reported audience of 4,460,077 and to a total audience that is estimated at not less than 7,000,000.
Authorization of sale of 294 prints, totaling 357 reels, of department films to cooperating or outside institutions, at a cost to purchasers of $14,280, compared with $9,845 in the fiscal year 1922 and $6,179 in the fiscal year 1921.

## GROWTH OF FILM DISTRIBUTION.

An outstanding development is the striking increase in the known audience reached by the films. Every user of our films is asked to

report the number of people to whom they are shown. The audience, as actually reported for 1922, was 1,937,570. The audience, as actually reported for 1923, was 4,460,077. Allowance should be made for possible exaggeration, but this consideration is balanced by the fact that many users failed to report their showings. In addition, there are no figures available in regard to the exact size of the audience reached by the department films that have been bought by cooperating or outside institutions. As such purchased films outnumber the films owned and circulated by the department, and as many of the purchasers are known to be actively and continually circulating the films to large audiences, figures on this circulation probably would compare favorably with the figures reported to the department.

Another item of circulation comes from the use of portions of our films on several occasions in the commercial "news weeklies," which claim audiences of several million people a day, and still another item—not to be figured in the domestic circulation—comes from the use of many of our films in foreign countries, such as at the Brazilian exposition in Rio de Janeiro, and the exhibition of our pork products film, "Behind the breakfast plate," in commercial theaters in England and the countries of continental Europe.

The growth in distribution is indicated also by the fact that in 1922 the number of film shipments from our laboratory was 2,066, while in 1923 the number rose to 2,715, and the films in most cases were sent out for longer periods. The number of reels in 1922 shipments was 5,559, while in 1923 the number was 7,436.

The number of subjects in distribution at the end of the fiscal year 1923 was 169, the number of prints was 1,047, and the total number of reels was 1,237.

The growth of distribution would seem to be a fair indication of the value of motion pictures in the department's work, but the figures are not more impressive than the written expressions that come frequently from users of the films. These statements in general are to the effect that the films have a remarkable effect in attracting large crowds to meetings, stimulating interest in the subjects under discussion, giving clear conceptions of unfamiliar ideas, and furnishing inspirational impetus to campaigns for community betterment.

On two occasions extension workers have been circularized as to their opinions of the usefulness of motion pictures in aiding their work. On each occasion the advocates of films won by a majority that approached unanimity. Despite this, it is probable that less than one-fourth of the extension workers have regular use of a projection machine. It is recommended that attention be given to this situation, and that if possible the extension workers be encouraged and aided in proper ways to obtain projection machines. The results that have been attained with motion pictures demonstrate that a projection machine is as much of a time saver in awakening interest and imparting information as an automobile is in covering the ground. It is confidently believed that the projection machine will come to be recognized as being as essential to the extension worker as his office typewriter and his "flivver." The best way to bring about the acquisition of projection machines is to encourage extension workers in interesting their local cooperating organizations in furnishing such equipment.

Another field of effort to which continuing attention should be given is the establishment of State film "libraries" or distributing centers. The great majority of our films are still distributed from Washington to all sections of the United States. Distribution should be decentralized and should be handled within each State by the agricultural college extension division. Such an arrangement would reduce transportation expenses, make the films more available on short notice, and allow local needs to be given better consideration. Several States have developed their distribution systems to a good degree of effectiveness, and their examples should be followed in the other States. So far as Department of Agriculture films are concerned, the way to the establishment of State libraries is open through the plan allowing purchase of prints of our films at the laboratory charge.

## BETTER QUALITY IN FILMS.

The qualifications of a good educational motion picture are that it teach a worth-while lesson clearly and efficiently, that it be correct as to facts and at the same time interesting enough to arouse and maintain interest, and that in every other way it be properly representative of the institution responsible for it.

In the past year these qualifications have been more nearly approached through a new system of criticism of scenarios and review of the finished pictures. At the direction of the Assistant Secretary, a scenario review committee was appointed in the division of methods of the Office of Extension Work, and this committee has functioned admirably in criticizing proposed pictures from the extension viewpoint. Previous to this criticism the scenarios are reviewed as to subject-matter by the originating bureau and other bureaus interested and are reviewed as to motion-picture technique in the Office of Motion Pictures. When the scenario is submitted for final approval prior to the actual production of the film it thus should have passed through criticism from every necessary angle and should be truly representative of the Department of Agriculture.

In the production of the film a subject-matter specialist should work with the motion-picture director and photographer, and thus the needs of both subject-matter and motion-picture technique should be supplied.

When the pictures are completed they are now submitted for review and criticism at meetings to which all bureaus in the department are invited to send representatives. This plan also was adopted at the direction of the Assistant Secretary and has proved to be a wise one in giving the films the benefit of criticism from various standpoints. There is no question that these new methods of criticism and review will result in better films so long as the criticism continues to be broad and liberal.

The number of new films completed in the past year, 28, is two below what has come to be regarded as possible with our present equipment and personnel. This results largely from the fact that more attention was given to quality rather than quantity, and it is believed that this should be a continuing policy. There is a large demand for new films, especially from the State agricultural colleges and extension divisions, but increased production should not

be attempted without increased personnel. At present our films have a high reputation for quality. We should strive to build up this reputation.

## NEEDS OF THE WORK.

In the last annual report for the motion-picture work it was stated that the outstanding needs were better quarters and higher salaries for some of our workers. The need for quarters has been met and the other need has been partially met. It is hoped that further salary adjustments will be furnished through the operation of the reclassification act.

The greatest need remaining is that definite provision be made for financing the motion-picture work. The office of motion pictures is still a mendicant and must obtain its funds from various sources. It is believed that results justify a specific congressional appropriation for motion-picture purposes.

## NEW FILMS.

The following motion pictures were completed during the fiscal year 1923:

Mollie of Pine Grove Vat. (3 reels, Bureau of Animal Industry.)
A Tale of Two Bulls. (1 reel, Bureau of Animal Industry.)
The Horse in Motion. (1 reel, Bureau of Animal Industry.)
Four Hundred Million Chickens. (1 reel, Bureau of Animal Industry.)
Behind the Breakfast Plate. (2 reels, Bureau of Animal Industry and Bureau of Agricultural Economics.)
Peanuts, $30,000,000 Worth. (1 reel, Bureau of Plant Industry.)
Keeping Out Bad Food. (1 reel, Bureau of Chemistry.)
Halting Foreign Plant Foes. (1 reel, Federal Horticultural Board.)
Red Enemy. (3 reels, Forest Service.)
Foresting the Sandhills. (1 reel, Forest Service.)
The Forest Ranger's Job. (1 reel, Forest Service.)
Crops and Kilowatts. (1 reel, Forest Service.)
Tests for Better Roads. (1 reel, Bureau of Public Roads.)
Roads to Wonderland. (1 reel, Bureau of Public Roads.)
Birds of a Feather. (1 reel, States Relations Service.)
Cranberries, and Why They Are Sometimes Bitter. (1 reel, Bureau of Plant Industry.)
Cotton—Dixie's Greatest Crop. (1 reel, Bureau of Plant Industry.)
Should I Buy a Tractor? (1 reel, Bureau of Agricultural Economics and Bureau of Public Roads.)
A Letter to Dad. (1 reel, States Relations Service.)
Bill Jones—Champion. (1 reel, States Relations Service.)

New films practically completed at the end of the year are:

Sugar Cane and Cane Sugar. (1 reel, Bureau of Plant Industry and Bureau of Chemistry.)
Beets From Seed to Sugar Bowl. (1 reel, Bureau of Plant Industry and Bureau of Chemistry.)
Cassina. (1 reel, Bureau of Chemistry.)
Seeing Washington. (1 reel, States Relations Service.)
Where Uncle Sam Raises Poultry. (1 reel, Bureau of Animal Industry.)
Future Forest Giants. (1 reel, Forest Service.)
Poison. (1 reel, Insecticide and Fungicide Board.)
White Pine Blister Rust in the West. (1 reel, Bureau of Plant Industry.)

The following films were materially revised:

Fighting Western Pine Beetles.
Production's Pulse.
The Golden Fleece.

Minor revisions were completed in the case of about 40 other subjects, this work involving changes in the negative and each existing print.

New films on which considerable work was done and which should be completed within the next few months include:

Hoppers. (Bureau of Entomology.)
Sir Loin of T-Bone Ranch. (Bureau of Animal Industry.)
The Woolly West. (Bureau of Animal Industry.)
Pines for Prosperity. (Forest Service.)
Laying Lumbricus Low. (Bureau of Plant Industry.)
The Modern Pied Piper. (Biological Survey.)
The Clean-up. (Bureau of Animal Industry.)
Bob's Ton Litter. (Bureau of Animal Industry.)
Bird Banding Work. (Biological Survey.)
The Soil a Heritage. (Bureau of Agricultural Economics, Bureau of Soils, and Bureau of Plant Industry.)

Preparatory work of various kinds was done on 15 other projects of less definite status.

## PURCHASES LARGEST ON RECORD.

Purchases of prints from our negatives during 1923 reached a new high total of 294 prints, for which the purchasers paid approximately $14,280. All purchases were made from a commercial film laboratory in New York after authorization from the motion-picture office, and were subject to conditions prohibiting any change in the films without approval from the department and prohibiting the insertion or addition to the films of any advertising matter. In effect these purchases add greatly to the usefulness of the films without cost to the department.

# REPORT OF THE OFFICE OF EXHIBITS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF EXHIBITS,
*Washington, D. C., October 12, 1923.*

SIR: I submit herewith the report of the work of the Office of Exhibits for the fiscal year ended June 30, 1923.

Respectfully,

JOSEPH W. HISCOX,
*In Charge of Exhibits.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

The work of the Office of Exhibits increased greatly during the past fiscal year. It is estimated that a total of 8,836,000 persons, or 26 per cent more than last year, viewed these exhibits at 114 fairs, conventions, and farmers' meetings at State colleges and other places where exhibits were shown. During the first half of the year the plan is to display our exhibits at State fairs. During the last six months of the fiscal year the exhibits are shown at special conventions and at miscellaneous meetings.

Associations which have had our exhibits invariably come back with a request for an exhibit the following year. One reason for this is that every effort has been made to make the exhibit material more attractive and to impart more information. Improved methods of handling the material and the cooperation of the bureaus have made possible a big improvement in our exhibits as a whole.

In the type of material sent on the circuits this year for general agricultural fairs there has been little change from last year. The circuits have had the benefit of material prepared for the 1921 National Dairy Show and International Livestock Exposition. In addition to the circuit work and the material sent to the western districts, many exhibits have been prepared for special occasions, such as the National Canners' Convention, the Pigeon and Pet Stock Show at Baltimore, and the Home and City Beautiful Exposition at Atlantic City.

An exhibit is a department affair. Suppose, for example, a State fair wants to emphasize some special subject this year, such as dairying. This material should represent not only information from the Dairy Division, but from the whole Bureau of Animal Industry and from other bureaus. Before plans are considered, suggestions are obtained from different bureaus. Specialists confer as to information they may have available which would be of value to persons interested in dairying. After the Office of Exhibits has correlated the suggestions from the Bureau of Public Roads concerning the ventilation of the dairy barn those from the Bureau of Animal Industry on breeding, from the Bureau of Plant Industry on the best forage crops, and from the Bureau of Agricultural Economics on the best milk-marketing methods, our staff undertakes to illustrate the ideas in an attractive and convincing way. The process is the same for all exhibits.

The Office of Exhibits collects ideas, and presents them in an attractive way. The ideas are illustrated by everything from the

object itself to the written word. The production section receives valuable assistance and cooperation from the various bureau representatives. In the warehouse at Alexandria many of our exhibits are assembled and packing cases made for them. From this warehouse 15 carloads of exhibits were shipped to the various showing points. In the distribution and presentation of our exhibits about 96 persons recruited from the different bureaus and State agencies cooperate. Men in the field may be detailed for the duration of an exhibition. Various State extension offices, State departments of agriculture, and local agencies often cooperate.

The real measure of the service rendered is shown by the fact that we not only get requests to come back to places where we have exhibited, but also because we get requests for our material from hundreds of new sources. Usually this is because a boys' and girls' club exhibit at one of the fairs, Sioux City, Iowa, for example, has shown a farmer how his son may earn enough money for a good agricultural education, or because a home exonomics exhibit has shown a farmer's wife how to obtain the comforts and conveniences that make rural life pleasant. It may have shown the farmer himself how to get weather and market forecasts by radio and how to use them to advantage. Perhaps the residents of a mountain district are made to realize their responsibility for action after having seen one of our forest-fire exhibits at a neighborhood fair.

The extent to which the department can send its exhibits around the country is limited because of the appropriation available for this purpose. Often many associations are so interested in having our exhibits that they pay transportation and installation costs. This good will on the part of the cooperators has enabled the department to present its information to hundreds of thousands of persons more than would have been possible otherwise.

The administrative and clerical section, consisting of 17 persons, in addition to the production and distribution functions already mentioned, has searched continually for new ideas and improved methods. Much of the success of an exhibit depends upon the novelty of its presentation. Economical production can result only from the use of efficient methods and the cheapest material that will give the desired effect. With these things in mind our staff has made many visits outside of Washington to institutions doing similar work or employing similar methods.

A careful and detailed index of references to publications about exhibit material has been started as a supplement to information already contained in our files. This index is a great timesaver and supplies information which previously, while not entirely unavailable, was not readily obtainable when time was an important factor.

Last year attention was called to the exhibit prepared for the Brazilian International Centennial Exposition. This exhibit was shown in the United States Building on the exposition grounds in Rio de Janerio from December 23, 1922, to July 1, 1923. It occupied 1,200 square feet of floor space and was viewed by about 400,000 persons. In August, 1922, three representatives from the department were sent to install and present the exhibit. The information acquired at this exposition will be of great value in the preparation of exhibits for other important international expositions.

The 12 booth exhibit for the boys' and girls' club encampment at Sioux City, Iowa, from September 17 to 23, was received enthusi-

astically. This exhibition resulted in requests for the display of this exhibit at the National Dairy Show and at several fairs. The Office also cooperated with the Eastern States Exposition held at Springfield, Mass., by arranging an attractive exhibit for the boys' and girls' club members from the 13 States represented.

Exhibits were made at the International Livestock Exposition and at the National Dairy Show. The material for last year's livestock exhibit was of a general nature, special emphasis being placed on breeding and on sheep. The exhibit for this year, in addition to the more general material, was devoted specially to feeding; to the raising of beef cattle, hogs, and horses; and to the marketing of animal products. In addition to the booth exhibits, healthy and unhealthy sheep were shown; these came from the Government farm at Middlebury, Vt., and from the Bureau of Animal Industry. There were also exhibits for boys' and girls' club members on poultry, swine, and other subjects.

The Dairy Show exhibit did not differ materially in subject matter but the facts were shown in a more striking manner. The exhibit was improved through the use of models of cows in addition to the pictures. Much valuable information as well as entertainment was given out from the little theater in which was shown a 5-minute animated cartoon, "The tale of two bulls." This film demonstrated the superiority of a purebred over a grade animal.

*List of exhibits held during the fiscal year ending June 30, 1923.*

| City. | Occasion. | Dates. |
|---|---|---|
| Aberdeen, S. Dak. | Tri-State and South Dakota State Fairs. | Aug. 23–Oct. 24, 1922. |
| Akron, Ohio. | Engineering class demonstrations, University of Akron. | Nov. 10, 1922–June 20, 1923. |
| Atlantic City, N. J. | American Home and City Beautiful Exposition. | June 16–Sept. 8, 1923. |
| Do. | Annual convention, National Canners' Association. | Jan. 22–28, 1923. |
| Baltimore, Md. | Baltimore Poultry, Pigeon, and Small Stock Show. | Dec. 5–9, 1922. |
| Do. | Better Homes Exposition, Maryland State University. | Apr. 21–27, 1923. |
| Baton Rouge, La. | Farmers' week, University of Louisiana. | Dec. 4–23, 1922. |
| Billings, Mont. | Midland Empire Fair. | Sept. 19–22, 1922. |
| Birmingham, Ala. | Alabama State Fair. | Oct. 2–7, 1922. |
| Boise, Idaho. | Idaho State Fair. | Sept. 25–30, 1922. |
| Brockton, Mass. | Brockton Fair. | Oct. 3–7, 1922. |
| Brooklyn, N. Y. | Botanical Garden school demonstrations. | Apr. 2–23, 1923. |
| Cambridge, Mass. | Engineering class demonstrations, Harvard University. | Nov. 10, 1922–June 20, 1923. |
| Champaign, Ill. | Farmers' week, University of Illinois. | Jan. 1–27, 1923. |
| Charleston, S. C. | Charleston County Fair. | Nov. 15–24, 1922. |
| Charlottesville, Va. | Virginia State Dairymen's Convention. | Mar. 5–11, 1923. |
| Chehalis, Wash. | Southwest Washington Fair. | Aug. 28–Sept. 2, 1922. |
| Cheyenne, Wyo. | Laramie County Milk Campaign. | May 1–7, 1923. |
| Chicago, Ill. | Engineering class demonstrations, Armour Institute of Technology. | Nov. 1, 1922–July 3, 1923. |
| Do. | International Livestock Exposition. | Dec. 2–9, 1922. |
| Do. | National convention, Motion Picture Theater Owners of America. | May 19–26, 1923. |
| Do. | International Pageant of Progress Exposition. | July 29–Aug. 30, 1922. |
| Cleveland, Ohio. | Annual convention, Association of Ice Cream Supply Men. | Oct. 17–21, 1922. |
| College Park, Md. | Farmers' day, University of Maryland. | May 26, 1923. |
| Do. | Annual meeting, Maryland State Veterinary Medical Society. | July 11–26, 1922. |
| Columbia, S. C. | South Carolina State Fair. | Nov. 23–2[illegible], 1922. |
| Concord, N. H. | New England Tuberculosis Eradication Conference. | June 12–13, 1923. |
| Council Bluffs, Iowa. | Mid-west Horticultural Exposition. | Oct. 19–Nov. 3, 1922. |
| Danville, Ill. | Illinois and Indiana Fair. | Aug. 27–Sept. 2, 1922. |
| Detroit, Mich. | Michigan State Fair. | Sept. 3–10, 1922. |
| Donaldsonville, La. | Southern Louisiana Fair. | Oct. 7–15, 1922. |
| Douglas, Wyo. | Wyoming Free State Fair. | Sept. 12–15, 1922. |
| Easton, Pa. | Engineering class demonstrations, Lafayette College. | Nov. 10, 1922–July 18, 1923. |
| Elko, Nev. | Elko County Fair. | Sept. 15–17, 1922. |
| Erie, Pa. | Erie's Big Exposition. | Aug. 21–26, 1922. |

*List of exhibits held during the fiscal year ending June 30, 1923*—Continued.

| City. | Occasion. | Dates. |
|---|---|---|
| Fort Worth, Tex. | Southwestern Exposition and Fat Stock Show. | Mar. 3–10, 1923. |
| Frederick, Md. | Frederick Fair | Oct. 17–20, 1922. |
| Fresno, Calif. | Fresno District Fair | Sept. 25–30, 1922. |
| Grand Forks, N. Dak. | North Dakota State Fair | July 24–29, 1922. |
| Greenville, S. C. | Southeastern Pure Food Show | Mar. 3–17, 1923. |
| Do. | Annual convention, United States Good Roads Association. | Apr. 16–21, 1923. |
| Grove City, Pa. | Milk for Health Campaign | Mar. 5–11, 1923. |
| Hagerstown, Md. | Great Hagerstown Interstate Fair | Oct. 10–14, 1922. |
| Hammond, La. | Florida Parishes Fair | Oct. 30–Nov. 14, 1922. |
| Hartford, Conn. | State Agricultural Exposition and Winter Fair. | Jan. 16–31, 1923. |
| Do. | Farmers' week | Jan. 23–27, 1923. |
| Harrisburg, Pa. | Farm Products Show | Jan. 21–27, 1923. |
| Helena, Mont. | Montana State Fair | Sept. 25–30, 1922. |
| Huron, S. Dak. | South Dakota State Fair | Sept. 11–15, 1922. |
| Ithaca, N. Y. | Engineering class demonstrations, Cornell University. | Nov. 10, 1922–July 15, 1923. |
| Jacksonville, Fla. | Florida State Fair | Nov. 17–25, 1922. |
| Kansas City, Mo. | American Royal Livestock Show | Nov. 18–25, 1922. |
| La Fayette, Ind. | Annual Egg Show, Purdue University | Apr. 18–May 8, 1923. |
| Lake Charles, La. | Calcasieu Parish Fair | Nov. 10–18, 1922. |
| Lewiston, Idaho | Lewiston-Clarkston Tri-State Fair | Sept. 12–16, 1922. |
| Lexington, Va. | Engineering class demonstrations, Virginia Military Institute. | Nov. 10, 1922–July 26, 1923. |
| Little Rock, Ark. | Arkansas State Fair | Oct. 9–15, 1922. |
| Louisville, Ky. | National Health Exhibit | Mar. 1–10, 1923. |
| Madison, Wis. | Farmers' week, University of Wisconsin | Jan. 1–Feb. 5, 1923. |
| Do. | Wisconsin State Fair | June 29, 1923. |
| Mandan, N. Dak. | Missouri Slope Agricultural Fair | Aug. 29–31, 1922. |
| Memphis, Tenn. | Memphis Tri-State Fair | Sept. 23–30, 1922. |
| Meridian, Miss. | Mississippi-Alabama Fair | Oct. 9–14, 1922. |
| Milwaukee, Wis. | Milk campaign, University of Wisconsin | Feb. 26–Mar. 4, 1923. |
| Do. | Wisconsin State Fair | Aug. 28–Sept. 2, 1922. |
| Muscatine, Iowa. | State Vegetable Growers' Association convention | Dec. 7–9, 1922. |
| Muskogee, Okla. | Oklahoma Free State Fair | Oct. 2–7, 1922. |
| New Brunswick, N. J. | Annual meeting, Agricultural Editors' Association. | June 25–28, 1923. |
| New Orleans, La. | American Wood Preservers' Association convention. | Jan. 13–Feb. 1, 1923. |
| New York, N. Y. | Paper Industries Exposition | Apr. 9–15, 1923. |
| Newark, N. J. | Health-week exhibit | June 4–9, 1923. |
| Omaha, Nebr. | Ak-Sar-Ben Fall Festival | Sept. 12–23, 1922. |
| Phoenix, Ariz. | Arizona State Fair | Oct. 30–Nov. 4, 1922. |
| Portage, Wis. | Milk-pasteurization campaign | Feb. 20–Apr. 4, 1923. |
| Portland, Oreg. | Pacific International Livestock Exposition | Nov. 4–11, 1922. |
| Prescott, Ariz. | Northern Arizona State Fair | Oct. 19–21, 1922. |
| Pueblo, Colo. | Colorado State Fair | Sept. 25–30, 1922. |
| Puyallup, Wash. | Western Washington Fair | Oct. 2–7, 1922. |
| Raleigh, N. C. | North Carolina Fair and Livestock meeting | Oct. 7–Dec. 6, 1922. |
| Raton, N. Mex. | Northern New Mexico State Fair | Sept. 12–15, 1922. |
| Riverside, Calif. | Southern California Fair | Oct. 10–15, 1922. |
| Rochester, N. Y. | Rochester Exposition | Sept. 4–9, 1922. |
| Rome, Ga. | Floyd County Fair | Oct. 3–7, 1922. |
| Sacramento, Calif. | California State Fair | Sept. 2–10, 1922. |
| St. Paul, Minn. | Minnesota State Fair | Aug. 23, 1922–June 29, 1923 |
| Do. | National Dairy Exposition | Oct. 7–14, 1922. |
| St. Joseph, Mo. | Milk campaign | Jan. 18–22, 1923. |
| Salem, Oreg. | Oregon State Fair | Sept. 25–30, 1922. |
| Salt Lake City, Utah. | Engineering class demonstrations, University of Utah. | Nov. 15, 1922–July 2, 1923. |
| Do. | Utah State Fair | Oct. 2–7, 1922. |
| Savannah, Ga. | Savannah Tri-State Exposition | Oct. 23–28, 1922. |
| Shreveport, La. | Louisiana State Fair | Oct. 19–29, 1922. |
| Sioux City, Iowa. | Interstate Fair | Sept. 17–23, 1922. |
| Spokane, Wash. | Spokane Interstate Fair | Sept. 4–9, 1922. |
| Springfield, Mass. | Eastern States Exposition | Sept. 17–23, 1922. |
| Stuttgart, Ark. | Arkansas State Rice festival | Nov. 3–7, 1922. |
| Timonium, Md. | Maryland State Fair | Sept. 4–9, 1922. |
| Toledo, Ohio. | National Farmers' Exposition | Dec. 7–15, 1922. |
| Topeka, Kans. | Kansas Free Fair | Sept. 11–16, 1922. |
| Trenton, N. J. | Trenton Interstate Fair | Sept. 26–30, 1922. |
| Waco, Tex. | Texas Cotton Palace | Oct. 21–Nov. 5, 1922. |
| Washington, D. C. | Agricultural Editors' Association convention | Apr. 26–31, 1923. |
| Do. | Wool class demonstrations, H. B. Cook (public) School. | Mar. 12–23, 1923. |
| Do. | Teachers' institute and class demonstrations, Wilson Normal School. | Dec. 24, 1922–Feb. 13, 1923. |
| Waterloo, Iowa. | Dairy Cattle Congress | Sept. 25–Oct. 1, 1922. |
| Wheeling, W. Va. | West Virginia State Fair | Sept. 4–9, 1922. |
| Wilson, N. C. | Eastern Carolina Exposition | Mar. 19–25, 1923. |
| Worcester, Mass. | New England Fair | Sept. 2–6, 1922. |
| Yakima, Wash. | Washington State Fair | Sept. 18–23, 1922. |

# REPORT OF THE LIBRARIAN.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE LIBRARIAN,
*Washington, D. C., September 1, 1923.*

SIR: I have the honor to submit herewith the executive report of the library for the fiscal year ended June 30, 1923.

Respectfully,

CLARIBEL R. BARNETT,
*Librarian.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

The outstanding events of the past year in the work of the library were the acquisition of 4,313 square feet of additional space in the basement, the changes in the arrangement of the stacks and reading rooms on the first floor, and the consolidation of the book collections of the Bureau of Plant Industry library with the main library collections. The additional space provides for 191 double-face sections of shelving, or, since it was necessary to remove 83 from other parts of the library, a net addition of 108 double-face sections, approximately 4,000 linear feet of shelving. This has brought much-needed relief to the crowded condition of the book shelves and provides a moderate amount of room for future growth. The space acquired, although in the basement and for that reason not very desirable, is on the whole fairly satisfactory for the storage of books and is perhaps the best that can be hoped for until the library has a permanent building especially designed for its use.

The complete consolidation of the book collections of the Bureau of Plant Industry library with the main library, which was anticipated in the report for last year, took place in the spring and has made necessary many readjustments of space and work. The pressure for office space in Laboratory A, occupied by the Bureau of Plant Industry, made it seem necessary to reduce the space occupied by the bureau library and hastened the transfer, which was already planned, of its collections to the main library. The transfer of the collections also made it seem desirable to transfer to the main library the card catalogues maintained in the bureau library, and the transfer of the catalogues made it necessary for the assistants who work on the catalogues to have their desks in the main library. The additional office space and the additional space needed for the catalogues necessitated taking out some of the book shelving on the first door. It was therefore decided to change the location of the reading room in order to provide more light and to make it easier of access by providing an entrance directly opposite the main entrance to the building. These changes had not been entirely completed at the close of the year. An urgently needed addition to the space avail-

able for current periodicals has been planned, but not yet provided. The changes have unavoidably caused a certain amount of inconvenience to patrons of the library, as well as to the library staff. They have at no time, however, interrupted the library service even for an hour.

The persons in charge of the different lines of work of the library were as follows: Miss Emma B. Hawks, assistant librarian, in general charge of reference and bibliographical work and circulation; Miss Ellen Hedrick, reference librarian (August 16, 1922, to June 15, 1923); Miss Helen M. Thompson, chief, catalogue and order division; Miss Lydia K. Wilkins, chief, periodical division; and Miss Ethel E. Smith, secretary to the librarian, in charge of correspondence, files, and personnel records. The names of the librarians of the various bureaus are given on page 5.

## ACCESSIONS.

On July 1, 1923, the library contained 168,468 accessioned books and pamphlets, of which 5,111 were added during the past year, while 34 publications no longer needed were discarded, making the net addition 5,077. There were also catalogued 4,181 which did not receive an accession number because they were later to be bound in volumes with other numbers of the same series, or for some other reason. The total accessions numbered 9,258. Of these there were added by purchase 2,040 volumes, 94 pamphlets, 300 serials and continuations, and 13 maps. The additions by gift and exchange were 720 volumes, 847 pamphlets, 3,684 continuations, and 15 maps, and 1,545 volumes were added by the binding of periodicals and serials. The periodicals received currently numbered 3,251, of which 2,277 were received by gift or exchange. Detailed statistics of accessions are given in Appendixes 5 and 7.

In the report for the fiscal year 1922 mention was made of a gift to the library of $150 from Dr. Henry C. Taylor, Chief of the Bureau of Agricultural Economics, which was notable as being the first gift of money ever received by the library aside from the regular congressional appropriations. During the past year the library was again indebted to Doctor Taylor for a gift of $100 for the purchase of books on economics. In addition, gifts were received from two other members of the staff of the Bureau of Agricultural Economics, namely, $30.35 from V. N. Valgren and $20 from Miss Caroline B. Sherman. These gifts evince an interest in the library which is greatly appreciated.

As in previous years, the library was the recipient by gift and exchange of a great number of books, periodicals, and pamphlets from American and foreign institutions, societies, agricultural officials, publishers, and private individuals. It is regretted that space does not permit the printing of a complete list of the donors who have aided the library in this way. Special mention should, however, be made of a unique collection of pamphlets, catalogues, articles, and correspondence in regard to the peony, which was made by the late Hon. James R. Mann, of the House of Representatives, and which, after his death, was given to the library by Mrs. Mann. The collection, which consists of 25 scrapbooks, is valuable for the information it contains, and, in addition, is of much interest for the side light which it throws upon the character of a man prominent in the political

life of this country. The gift represents the first special collection on one subject which has ever been given to the library. A beginning having been made, it is hoped that many other agricultural collections may be received. As the national agricultural library, it would seem that this library should attract to itself many such gifts of special collections and manuscript material, for in no other center in the country can they be of such great service.

Another notable gift during the past year was a valuable addition to the library's extensive collection of nursery and seed-trade catalogues. The donor was C. R. Orcutt, of La Jolla, Calif., a botanical explorer, collector, and writer of note. An outgrowth of Mr. Orcutt's wide acquaintance with the horticultural trade of the world has been the accumulation through a period of more than four decades of an exceptionally large and representative collection of the trade literature. The library was fortunate in being selected as the recipient of the greater part of this collection, which added 339 publications new to the library's files. The total number of catalogues now contained in the library's collection of horticultural catalogues is 25,193, of which 20,731 are United States catalogues and 4,462 are foreign.

Among out-of-print periodicals, the most prized acquisition to the library was the Agricultural Museum, the first agricultural periodical published in this country. The library previously possessed a few scattering numbers, but during the past year it received what is believed to be a complete file through the gift of volume 1 from H. A. Kellar, of the McCormick Library, Chicago, and the transfer from the Library of Congress of volume 2, Nos. 1 to 11. The periodical was published in Georgetown, D. C., from July, 1810, to May, 1812, and was edited by David Wiley, who was also secretary of the Columbian Agricultural Society. It precedes by 10 years the American Farmer, of Baltimore, which is generally referred to as the first agricultural periodical published in this country.

While the amount spent during the past year for the purchase of books was somewhat larger than in previous years, the number of out-of-print books was smaller on account of the limited funds available for such purchases after meeting the demand for current books and periodicals. Among the more important of the old books acquired were the following: Bry, J. T. de, Florilegium Novum (1612); Estienne, Charles, De Landwinninghe Ende Hoeve (1582); Heresbach, Conrad, Foure Books of Husbandry (1577); Hesse, Heinrich, Neue Garten-Lust (1703-1705); Virgil, Georgicorum libri quatuor, the Georgics of Virgil, with an English translation and notes (1741); Vettori, Pietro, Trattato delli Lodi et della Coltivazione degl'Ulivi (1569). Among the more important purchases of current books should be noted the fourth and final volume of the Monograph of the Pheasants, by William Beebe, and volume I of A Natural History of Ducks, by John C. Phillips. Among the reference books acquired are Allgemeine Deutsche Biographie, 56 volumes; Dictionary of Applied Physics, by R. T. Glazebrook, volumes 1 to 4; and The Practice of Medicine, by Frederick Tice, in 10 loose-leaf volumes, which was purchased at the request of the office of drug control, Bureau of Chemistry, for use in its court work under the food and drugs act. Volumes 1 and 10 to 41 of the Zeitschrift für Wissenschaftliche Zoologie have been secured, completing the set of this valuable journal, with the exception of the rare volumes 2 to 9.

## CATALOGUING.

The work of the Catalogue Division suffered during the past year through the loss of five of the experienced cataloguers. Three left the main library to accept positions with higher salaries in one of the bureau libraries, and it was necessary to transfer two temporarily to other divisions of the library. As a result, the amount of cataloguing was less than in the previous year and the number of pieces awaiting cataloguing was much greater. Nevertheless a larger number of catalogue cards were prepared for printing by the Library of Congress, this being due to the fact that the printing of cards for articles in four foreign agricultural periodicals, which was interrupted by the war, was resumed and brought up to date. The periodicals are the following: Annales de la science agronomique; Annales de l'Institut national agronomique, Paris; Landwirtschaftliche Jahrbücher, and Die landwirtschaftlichen Versuchsstationen. There was also a larger addition of cards to the card catalogue, which now consists of approximately 480,000 cards.

## USE OF THE LIBRARY.

The total number of books recorded as circulated by the main library and the bureau libraries was 82,741, of periodicals 156,298, making a total of 239,039. As in the past, no records have been kept of the use of the library for reference, and certain of the bureaus have no record of circulation. The main library also keeps no record of the circulation of current periodicals. The number of loans to libraries out of the city was 1,290, an increase of 142 over last year. The number of publications borrowed from other libraries in Washington was 3,595 and from libraries in other cities 53, the corresponding figures for last year being 4,028 and 69. More detailed statistics are given in Appendixes 1 to 4.

The position of reference librarian, which has been vacant since 1919, was filled this year by the appointment of Miss Ellen Hedrick, who, however, was obliged to resign in June, leaving the position filled only temporarily by the appointment of Miss E. L. Ogden. Besides the use of the library by department workers, its resources have brought scholars, investigators, business men, and students from outside to consult it. Workers from other Government departments and bureaus and from various offices in Washington are frequent readers, and scientists from other parts of the country visit it with long lists of references to literature which they have been unable to consult, or at least to consult conveniently, elsewhere. Many inquiries are received over the telephone from persons both inside and outside of the department and range from questions as to the middle name of a department employee to requests for the collection of all the literature in the library bearing on the living conditions on farms in the United States as compared with those of France and Italy. Letters asking for information and bibliographies are also received almost daily. The library is able to respond to the calls for bibliographies only to a limited extent, being forced often by lack of assistance to confine the lists sent to the titles which appear in its card catalogue.

## BUREAU AND DIVISION LIBRARIES.

The following table gives a list of the various branch libraries in the bureaus and divisions. The material is taken from the reports of the librarians, which, unfortunately, it is impossible, because of lack of space, to give in full. An account of the bibliographical work of the various libraries is given under the heading "Bibliography" and their statistics of circulation are included in the table given in Appendix 1.

*Books, pamphlets, and periodicals in bureau, division, and office libraries.*

| Bureau or office. | Number employed. | Number of books. | Number of pamphlets. | Number of periodicals currently received. | Number of regular borrowers. | Number of regular borrowers to whom periodicals are circulated. |
|---|---|---|---|---|---|---|
| Bureau of Agricultural Economics, Miss Mary G. Lacy, librarian | 11 | [1] 23,000 | [2] | [1] 1,300 | [2] | [3] 113 |
| Bureau of Animal Industry, Miss Carrie B. Sherfy, librarian | 3 | 2,670 | [1] 2,900 | 558 | 133 | 128 |
| Animal Husbandry Division, Miss Jessie Urner, librarian | 2 | 3,048 | 3,924 | 160 | 46 | ..... |
| Bureau of Chemistry, Miss Louise Duvall, librarian | 4 | [1] 8,200 | [2] | 448 | 247 | 100 |
| Bureau of Entomology, Miss Mabel Colcord, librarian | 3 | 8,642 | 9,925 | 550 | 115 | 20 |
| Forest Service, Miss Helen E. Stockbridge, librarian | 1 | [4] 23,386 | [2] | 172 | 151 | 70 |
| Bureau of Plant Industry, Miss Marjorie F. Warner, librarian | 9 | [1] 600 | [1] 1,100 | 988 | [2] | 167 |
| Bureau of Public Roads, Miss Orrena L. Evans, librarian | 3 | [1] 2,557 | 6,294 | 275 | 139 | 92 |
| States Relations Service, Miss Martha L. Gericke, librarian | 9 | [1] 3,500 | [1] 9,500 | [1] 900 | 115 | 65 |

[1] Approximate figures.
[2] Figures not available.
[3] Offices.
[4] Books and pamphlets.

The work of the libraries of the Bureaus of Animal Industry, Chemistry, Entomology, Public Roads, the Forest Service, and the States Relations Service has continued along the lines indicated in previous reports. In the report of the Bureau of Agricultural Economics library for 1921–22 the most notable feature was the physical consolidation of the libraries of the former Bureau of Markets and Crop Estimates and the Office of Farm Management. The outstanding feature of the 1922–23 report is the unifying of these collections by the elimination of duplicate material, the consolidation and orderly rearrangement of periodical files, the combining of card records, the reading of shelves to see that books had not been misplaced in the moving, and other work of this sort. The work with current periodicals is very heavy, and the regular circulation of numbers to workers in the bureau presents a serious problem which is also found in the main library and in most of the bureau libraries. Long circulation lists mean that many periodicals reach the borrower so late as to be of little service except for reference. The value of the circulation service with periodicals decreases in inverse ratio to its size. In an attempt to minimize this difficulty a readers' table has been arranged in the Bureau of Agricultural Economics library, on which are placed the latest numbers of journals on general economics and others for which there is a long circulation list,

to remain until the arrival of the next number. It is hoped that this plan will do more to keep workers in touch with the current literature of economics than the former circulation of these journals could possibly do. This plan has been followed for years in the Bureau of Entomology for the bulk of its journals and has given satisfaction. The files of material relating to the foreign work of the Bureau of Agricultural Economics, which had been kept in the Foreign Section, have been placed under the library of the bureau, which has worked out a plan for the rapid handling of the material as received from the State Department and the bureau's agents abroad, and has assumed the responsibility of seeing that the material reaches the desks of those whose work it concerns within a few hours of its receipt. The Division of Statistical and Historical Research pays the salary of the assistant in charge of the work.

In January, 1923, the Bureau of Agricultural Economics library began the publication of the Library Supplement to the Bureau News. It was felt that an opportunity to call attention to and even to abstract material of special interest and to place before bureau workers short reading lists on subjects of direct interest was desirable, in addition to the list of accessions which for some time has been appearing in the Bureau News. Four supplements appeared in the first six months of 1923.

The radical changes in the Bureau of Plant Industry library have been touched upon on page 1 of this report. By the transfer to the department library of most of the book collection, the catalogues, and two members of the staff, the space occupied by the bureau library has been reduced from three and a half to one and a half rooms. The circulation of periodicals, the care of mailing lists, the administrative work and correspondence, and some of the bibliographical and reference work continue to be conducted in the bureau library. The following quotation from the report of the librarian of the Bureau of Plant Industry sums up the results, in so far as they are yet apparent, of this interesting experiment in the partial consolidation of the work of a bureau library with that of the department library:

> The location of the bureau catalogue workers at the department library makes it possible for them to see and enter the new books and periodicals as soon as they are received. This was not feasible when the publications were sent to the bureau, and there was usually more or less delay.
>
> The bureau catalogues are now more used by the department library staff, owing to their availability. Also users of the department library interested in plant industry subjects, who did not formerly know the resources of the bureau catalogues or had not time to go to them, now have them accessible and they are more widely consulted.
>
> Some botanical entries formerly made in the main catalogue are now eliminated, thus saving duplication of indexing, and since the catalogues are side by side, there probably will be some elimination from the bureau catalogues of subjects fully covered in the main catalogue.
>
> The transfer of the bureau book charging to the department library was described in the report for 1921–22, but at that time the effect upon the work was not fully known. This elimination of duplicate charging has saved practically the full time of one assistant in the bureau library, with a comparatively small amount of extra work for the department library assistants. Also there has been a considerable saving of supplies and equipment as well as space in the bureau library.
>
> There has been some complaint that the service is not so prompt or satisfactory as that formerly given by the bureau, and the staff of the bureau library has missed the inspiration of more direct contact with the bureau workers. But with the development of the plan it is hoped that more close and satisfactory relations may again be established. The transfer of the book collections and catalogues, while causing some

inconvenience to Laboratory A, has undoubtedly been an advantage to the bureau employees outside of Laboratory A, as they now need go only to one place to consult catalogues and books.

To a greater extent than was possible before the bureau library staff now has the benefit of the larger facilities of the department library, as well as the advice and assistance of its experts, and the department library the benefit of the special knowledge of the bureau workers located there.

It is reported with regret that Miss Marjorie F. Warner, librarian of the Bureau of Plant Industry, resigned that position on June 30, 1923, and is taking a year's leave of absence, at the end of which time it is hoped that she may be able to return to the bureau. She was appointed librarian of the bureau in May, 1922, but had been for many years before that in charge of the bibliographical investigations project of the office of economic and systematic botany. Her knowledge of botanical and older horticultural literature is probably superior to that of anyone in the department and her assistance in the building up of the department's collections in these lines will be greatly missed during her absence.

## BIBLIOGRAPHY.

The "List of serials currently received in the United States Department of Agriculture library," which was reported as being in press last year, was received from the printer in February and is in constant demand. It comprises 358 pages. In response to frequent requests for references to the literature of agricultural history, the reference librarian during the past year has been working on a list of such references. When completed it will probably be made available in mimeographed form. A list of the more important accessions to the department library has been published each week in the Official Record of the department.

No. 5 of the mimeographed series, called "Bibliographical Contributions of the Library," was issued in April, and is entitled "Index to some sources of current prices." It consists of 124 pages and was compiled by Mrs. Eva T. Shively, of the Bureau of Agricultural Economics library. The index is arranged in three columns, the first giving the commodities in alphabetical order, the second the name of the market from which prices are quoted, the third the name of the newspaper or other journal in which the quotations are to be found. The information given in this list is in almost daily demand, and the Bureau of Agricultural Economics expects to add to the periodicals indexed and later to issue a new and fuller edition incorporating these and the constructive suggestions for the improvement of the list which have been received.

Important card indexes maintained by bureau libraries, which have been kept up as usual during the past year, are: Indexes to veterinary science and to dairying, Bureau of Animal Industry; index to the literature of economic entomology, and slip index to publications of the bureau, Bureau of Entomology; index to the literature of forestry and allied subjects, Forest Service; indexes to botanical literature, plant pathology, also a special catalogue of department and outside publications by bureau authors, a union catalogue of botany, and an index to botanical illustrations, Bureau of Plant Industry; index to the literature of roads and allied subjects, Bureau of Public Roads. The Bureau of Agricultural Economics

library publishes in the weekly issues of the Bureau News a list of library accessions of interest to the bureau; the Bureau of Entomology library does the same for its Bureau Newsletter; the Forest Service library publishes a monthly list of current literature in the Journal of Forestry; the Bureau of Plant Industry library issues in mimeographed form a list of "Current author entries," and the Bureau of Public Roads a mimeographed list of the contents of periodicals, all of these lists being in continuation of work of previous years. Most of the bureau libraries also prepare lists on special subjects connected with the work of the bureau as need arises.

### BINDING.

As has been the case for several years past, the binding work has suffered from changes in the staff. The assistant who was placed in charge of the work on July 1, 1922, following the resignation of the former incumbent, himself resigned in February to go to another library at a larger salary. One of the cataloguers was then placed temporarily in charge and is now carrying on the work. For the first seven months of the year there was no second assistant in the work. The number of volumes bound was therefore greatly diminished, to the disadvantage of the library. Exact figures will be found in Appendix 8. As an experiment, the library had 2,000 volumes treated by an oil process said to be efficacious in preserving the leather bindings.

### EXCHANGES AND MAILING LISTS.

During the year 1,709 orders were issued on the Division of Publications for the mailing of department publications which were requested by foreign institutions and officials and by societies and private individuals from whom publications are received in exchange. The total number of addresses appearing on the foreign mailing lists maintained by the department for exchange purposes does not differ greatly from the number reported last year, being approximately 4,000 in addition to the list of 1,000 addresses to which the Monthly List of Publications of the department is sent.

### ORDER WORK AND BOOKKEEPING.

The record of the order work and bookkeeping for the last three years is given in the following table:

| | 1921 | 1922 | 1923 |
|---|---|---|---|
| Requisitions issued for periodicals and books | 1,569 | 2,060 | 2,481 |
| Requisitions issued for supplies | 67 | 83 | 126 |
| Shop requests | 132 | 122 | 160 |
| Requisitions for printing and binding | 41 | 77 | 49 |
| Vouchers audited for payment | 956 | 1,176 | 1,337 |

A comparison of the receipts and expenditures of the library for the past 10 years is given in the table in Appendix 10.

## LIBRARY STAFF.

There were 8 resignations and transfers from the bureau libraries during the year, as follows: 1 librarian, 1 assistant librarian, 3 library assistants, 2 clerks, and 1 messenger.

The loss, previously mentioned, of Miss Marjorie F. Warner, librarian of the Bureau of Plant Industry, is severely felt.

The Bureau of Agricultural Economics sustained serious losses in its staff, including the transfer of its assistant librarian to one of the other offices of the bureau.

In the main library there were during the year 7 resignations and 4 transfers. Of these 11 who resigned or were transferred 1 was the reference librarian, who found it necessary to resign on account of family affairs, 6 were library assistants, 2 were clerical assistants, and 2 were messenger boys. Of the 6 library assistants who left the library, 2 resigned on account of illness in their families, 1 resigned to be married, and 3 were transferred to another bureau of the department. The 2 clerks who left the library were offered more remunerative positions, one in another Government department and the other in a library outside of Washington.

For three months one of the library assistants of the main library was assigned to the Bureau of Animal Industry library in exchange for a member of its staff, and the experience thus gained has been beneficial to both.

The number of employees on the main library staff at the close of the fiscal year was 36. Of this number four were temporary assistants. The number employed by the bureau and office libraries was 45. Of the total number employed in the main library and the bureau and office libraries 68 were women and 13 were men, divided as follows: 14 in administrative work, including the librarian of the department, the heads of divisions in the main library, and the librarians of the bureaus and offices; 34 library assistants, 18 clerical assistants, 11 messengers, and 4 charwomen.

Staff meetings, including the forces of both the main library and and the bureau libraries, were held monthly from October to June, and were addressed by Col. W. B. Greeley, Chief Forester, on the work of the Forest Service; by Dr. T. S. Palmer, of the Bureau of Biological Survey, at three different meetings, on bibliographical subjects; by Prof. A. S. Hitchcock, of the Bureau of Plant Industry, on books and taxonomic investigations; by C. A. Reed, of the Bureau of Plant Industry, on his trip to China; by W. C. Markham, of the American Association of State Highway Officials, on the highway situation and the work of the Bureau of Public Roads; and by members of the library staff, who reported on the annual conferences of the American Library Association and the Special Libraries Association. The former conference was attended by the assistant librarian of the department and by the librarian of the Bureau of Agricultural Economics, the latter conference by the reference librarian of the department and by the librarians of the bureaus of Public Roads and States Relations Service.

The librarian of the department library has served throughout the year as chairman of the committee on professional problems of the District of Columbia Library Association and as a member of the

Committee on Federal and State Relations of the American Library Association, the librarian of the Bureau of Agricultural Economics has been a member of the methods committee of the Special Libraries Association and also secretary of the agricultural libraries section of the American Library Association, and the librarian of the Bureau of Entomology as a member of the public documents committee of the American Library Association, has assisted in the preparation of a report on the depository libraries of the United States.

### LIBRARY CLASS.

A class in library science in the graduate school of the department was conducted during the year by the reference librarian, and consisted of two courses of 30 periods each from October to June. The first course covered cataloguing and classification; the second, reference work and bibliography. Eighteen persons, almost all of them employees of the main library or of bureau libraries who had had little training in library work, availed themselves of the opportunity offered each term. The spirit shown by these students and their industry in prosecuting their studies after a hard day's work were greatly to their credit and testified to their determination to make their services more valuable to the department.

### ECONOMIES.

The library, which has always had in mind the necessity for economy in its administration, has paid even stricter attention to this matter during the past year. Sheets of paper, cards, and slips which have been used on one side are made use of for notes and rough drafts. Wrapping paper is saved and used again. Envelopes used for correspondence between the main library and the bureau libraries are saved and used over and over.

The largest saving, however, was in the matter of shelving for the space recently acquired. If it could have been afforded it would have been very desirable to have metal shelving to match what is already in the library. Instead of this, wooden shelving made in the shops of the department was used. It is by no means so satisfactory, as the shelves are not movable except in a few sections, and the cases are not so convenient or durable as the metal ones. The substitution effected a saving of nearly three-fourths or approximately $1,500 on the cost of the shelving.

## APPENDIX 1.

*Combined statistics of circulation.*

| Bureau. | Number of books charged— | | | | | | | | Number of periodicals charged. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | To individuals. | | To main library. | | To branch libraries. | | Total. | | | |
| | 1922 | 1923 | 1922 | 1923 | 1922 | 1923 | 1922 | 1923 | 1922 | 1923 |
| Main library | 13,254 | 20,646 | ..... | ..... | 29,640 | 25,432 | 42,894 | 46,078 | [1] | [1] |
| Bureau of Agricultural Economics | [1] | [1] | [2] 698 | [1] | [2] 985 | ..... | [3] 9,664 | 13,211 | [4] 15,922 | [1] |
| Bureau of Animal Industry | 4,043 | 4,753 | 217 | 285 | ..... | ..... | 4,260 | 5,038 | 55,789 | 47,605 |
| Bureau of Chemistry | 7,708 | 7,962 | 654 | 757 | 87 | 121 | 8,449 | 8,840 | 25,839 | 26,133 |
| Bureau of Entomology | 2,448 | 2,844 | 162 | 264 | 124 | 94 | 2,734 | 3,202 | 3,246 | 2,884 |
| Forest Service | 2,738 | 2,754 | 457 | 394 | 1 | 15 | 3,196 | 3,163 | 7,391 | 7,452 |
| Bureau of Plant Industry | 11,492 | ..... | 400 | ..... | 20 | ..... | 11,912 | ..... | 55,992 | 58,009 |
| Bureau of Public Roads | 2,602 | 3,138 | 66 | 66 | 15 | 5 | 2,683 | 3,209 | 11,851 | 14,215 |
| | 44,285 | 42,097 | 2,654 | 1,766 | 30,872 | 25,667 | 85,792 | 82,741 | 176,030 | 156,298 |

[1] Figures not available.
[2] Figures for Bureau of Crop Estimates library.
[3] Figures for Bureau of Markets and Crop Estimates library and partial figures for Office of Farm Management library.
[4] Incomplete figures.

## APPENDIX 2.

*Circulation statistics of the main library, by months and years, for the fiscal years 1914 to 1923.*

| Month. | 1913–14 | 1914–15 | 1915–16 | 1916–17 | 1917–18 | 1918–19 | 1919–20 | 1920–21 | 1921–22 | 1922–23 |
|---|---|---|---|---|---|---|---|---|---|---|
| July | 2,651 | 3,019 | 3,077 | 2,932 | 3,113 | 2,860 | 2,687 | 2,827 | 3,681 | 3,017 |
| August | 2,083 | 2,567 | 3,285 | 2,883 | 3,027 | 2,616 | 3,216 | 2,867 | 3,152 | 2,959 |
| September | 2,531 | 2,793 | 3,334 | 2,955 | 2,968 | 2,232 | 2,678 | 2,790 | 2,866 | 3,044 |
| October | 3,301 | 3,903 | 4,183 | 4,421 | 3,617 | 2,474 | 3,444 | 3,101 | 3,845 | 4,219 |
| November | 3,232 | 3,352 | 4,439 | 4,409 | 3,462 | 2,684 | 2,981 | 3,381 | 3,650 | 4,576 |
| December | 3,226 | 3,570 | 4,140 | 3,797 | 3,137 | 2,728 | 2,897 | 3,369 | 3,448 | 4,084 |
| January | 4,454 | 4,260 | 4,888 | 4,839 | 4,099 | 3,572 | 3,668 | 3,932 | 3,749 | 4,357 |
| February | 3,618 | 3,638 | 4,715 | 4,625 | 3,603 | 3,830 | 3,346 | 3,481 | 3,773 | 4,445 |
| March | 4,021 | 3,980 | 5,028 | 4,640 | 3,676 | 3,920 | 3,699 | 3,840 | 4,481 | 4,663 |
| April | 3,623 | 3,514 | 4,052 | 3,766 | 3,444 | 3,608 | 3,497 | 4,444 | 3,239 | 3,826 |
| May | 2,951 | 3,072 | 4,136 | 3,616 | 3,531 | 3,327 | 3,103 | 3,326 | 3,319 | 3,716 |
| June | 3,188 | 3,285 | 3,637 | 3,476 | 2,770 | 2,606 | 3,085 | 3,483 | 3,691 | 3,172 |
| Year | 38,879 | 40,953 | 48,914 | 46,339 | 40,447 | 36,457 | 38,301 | 40,841 | 42,894 | 46,078 |

## APPENDIX 3.

### Interlibrary Loans.

*Record of books lent outside of Washington during the fiscal years 1914 to 1923.*

| States, etc. | Fiscal year— | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
| Alabama | 3 | 3 | | 10 | | | 10 | 17 | 5 | 6 |
| Arizona | 6 | 4 | 14 | | 7 | 4 | 4 | 23 | | 1 |
| Arkansas | | 2 | 3 | 4 | 5 | 9 | 19 | 32 | 21 | 24 |
| California | 27 | 26 | 50 | 38 | 13 | 28 | 43 | 16 | 18 | 29 |
| Colorado | 12 | 27 | 24 | 16 | 7 | 5 | 10 | 18 | 9 | 37 |
| Connecticut | 4 | 4 | 2 | 2 | 5 | 1 | 7 | 13 | 5 | 5 |
| Delaware | 18 | 11 | 10 | 6 | 17 | 11 | 30 | 21 | 28 | 35 |
| Florida | 20 | 44 | 21 | 15 | 21 | 17 | 7 | 5 | 13 | 33 |
| Georgia | 14 | 15 | 37 | 24 | 5 | 4 | 6 | 12 | 31 | 15 |
| Idaho | 5 | 9 | 5 | 10 | 6 | 4 | 8 | 1 | 7 | 1 |
| Illinois | 12 | 7 | 66 | 30 | 44 | 49 | 23 | 20 | 17 | 13 |
| Indiana | 7 | 25 | 20 | 13 | 11 | 4 | 13 | 38 | 7 | 32 |
| Iowa | 24 | 63 | 80 | 40 | 52 | 15 | 22 | 72 | 59 | 69 |
| Kansas | 12 | 59 | 71 | 38 | 31 | 41 | 22 | 3 | 23 | 15 |
| Kentucky | 4 | 25 | 7 | 4 | 8 | 13 | 15 | 13 | 30 | 34 |
| Louisiana | 2 | 2 | 10 | 8 | 21 | 9 | 5 | 5 | 15 | 15 |
| Maine | 11 | 8 | 22 | 16 | 10 | 2 | 3 | 1 | | 1 |
| Maryland | 7 | 25 | 28 | 48 | 30 | 10 | 21 | 24 | 17 | 66 |
| Massachusetts | 18 | 36 | 25 | 33 | 22 | 10 | 37 | 16 | 34 | 37 |
| Michigan | 35 | 22 | 37 | 38 | 21 | 9 | 17 | 50 | 24 | 41 |
| Minnesota | 7 | 64 | 78 | 50 | 44 | 63 | 89 | 88 | 44 | 60 |
| Mississippi | 3 | 4 | | 1 | 1 | 1 | | 4 | 2 | 2 |
| Missouri | 19 | 18 | 15 | 19 | 6 | 2 | 10 | 6 | 22 | 21 |
| Montana | 13 | 5 | 15 | 19 | 37 | 17 | 13 | 7 | 6 | 38 |
| Nebraska | 20 | 20 | 18 | 10 | 4 | | 15 | 7 | 7 | 14 |
| Nevada | | | 3 | 1 | 1 | | 1 | | 2 | 1 |
| New Hampshire | 5 | 3 | 2 | 8 | 10 | 7 | 6 | 9 | 11 | 22 |
| New Jersey | 24 | 83 | 53 | 76 | 28 | 42 | 49 | 89 | 63 | 107 |
| New Mexico | 4 | 3 | 9 | 8 | 6 | 7 | 6 | 11 | | 1 |
| New York | 113 | 142 | 127 | 148 | 103 | 66 | 85 | 81 | 117 | 101 |
| North Carolina | 30 | 48 | 17 | 15 | 7 | 1 | 6 | 26 | 43 | 27 |
| North Dakota | 11 | 3 | 11 | 3 | 6 | 6 | 5 | 14 | 10 | 8 |
| Ohio | 103 | 78 | 29 | 41 | 56 | 9 | 30 | 32 | 35 | 32 |
| Oklahoma | 1 | | | | | | 1 | 7 | 8 | 5 |
| Oregon | 44 | 51 | 66 | 51 | 73 | 5 | 19 | 53 | 30 | 15 |
| Pennsylvania | 19 | 21 | 29 | 19 | 21 | 10 | 30 | 51 | 37 | 35 |
| Rhode Island | 1 | 6 | 2 | 17 | 4 | 2 | 12 | 5 | 8 | |
| South Carolina | 1 | 1 | 22 | 27 | 14 | 2 | 2 | 12 | 11 | 15 |
| South Dakota | | 3 | | | | | 3 | | 3 | |
| Tennessee | 26 | 20 | 31 | 22 | 19 | 11 | 10 | 11 | 12 | 33 |
| Texas | 9 | 23 | 11 | 38 | 8 | 9 | 4 | 21 | 14 | 19 |
| Utah | | 8 | 17 | 16 | 8 | 8 | 14 | 19 | 22 | 12 |
| Vermont | 30 | 21 | 9 | 3 | 3 | 10 | 3 | 7 | 12 | 11 |
| Virginia | 54 | 32 | 26 | 18 | 4 | 10 | 19 | 46 | 28 | 38 |
| Washington | 14 | 8 | 11 | 2 | 8 | 21 | 12 | 31 | 4 | 7 |
| West Virginia | 2 | 12 | 16 | 8 | 19 | 19 | 10 | 13 | 15 | 13 |
| Wisconsin | 31 | 38 | 41 | 34 | 36 | 62 | 2 | 48 | 63 | 35 |
| Wyoming | | 4 | 5 | 3 | | 6 | 4 | 6 | 11 | 3 |
| Canada | | 1 | | 1 | 1 | 3 | 1 | 2 | 1 | |
| Cuba | | | | | | | | | 1 | |
| Hawaii | 2 | | | 3 | 2 | 1 | | | | |
| Porto Rico | 67 | 57 | 43 | 39 | 28 | 11 | 14 | 32 | 9 | 9 |
| Island of Guam | | | | | | 2 | 1 | | | |
| Alaska | | | 2 | | | | 1 | | 1 | |
| Panama | 1 | | | | | | | 1 | | |
| Total | 896 | 1,196 | 1,240 | 1,093 | 893 | 658 | 799 | 1,139 | 1,015 | 1,193 |
| Photostat copies of articles | 47 | 101 | 129 | 168 | 84 | 145 | 142 | 78 | 126 | 89 |
| Typewritten copies of articles | 17 | 12 | 9 | 12 | 11 | | 17 | 11 | 7 | 8 |
| | 960 | 1,309 | 1,378 | 1,273 | 988 | 803 | 958 | 1,228 | 1,148 | 1,290 |

## APPENDIX 4.

*Summarized statement of books borrowed from other libraries during the fiscal years 1914 to 1923.*

| Library from which borrowed. | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Library of Congress | 3,868 | 4,365 | 5,279 | 4,629 | 3,567 | 4,126 | 3,385 | 3,290 | 3,180 | 2,953 |
| Surgeon General's library | 805 | 750 | 939 | 962 | 878 | 607 | 476 | 470 | 511 | 364 |
| Smithsonian Institution and National Museum | 205 | 130 | 227 | 141 | 124 | 110 | 75 | 100 | 68 | 55 |
| Geological Survey | 137 | 101 | 92 | 57 | 49 | 64 | 73 | 61 | 69 | 50 |
| Patent Office | 21 | 19 | 29 | 49 | 25 | 36 | 18 | 20 | 40 | 41 |
| Bureau of Education | 31 | 15 | 43 | 41 | 4 | 11 | 4 | 21 | 22 | 9 |
| Public Library | 29 | 20 | 33 | 11 | 13 | 21 | 10 | 18 | 39 | 56 |
| Hygienic Laboratory | 6 | 3 | 45 | 21 | 15 | 12 | 12 | 3 | 28 | 10 |
| Bureau of Standards | 4 | 2 | 2 | 7 | 2 | 2 | 6 | 8 | 17 | 11 |
| Other libraries in Washington | 60 | 56 | 85 | 92 | 40 | 37 | 62 | 86 | 54 | 46 |
| Total from libraries in Washington. | 5,166 | 5,463 | 6,774 | 6,010 | 4,717 | 5,026 | 4,121 | 4,077 | 4,028 | 3,595 |
| Libraries outside of Washington | 62 | 58 | 86 | 82 | 35 | 70 | 39 | 58 | 69 | 53 |
| Grand total borrowed from other libraries | 5,228 | 5,521 | 6,860 | 6,092 | 4,752 | 5,096 | 4,160 | 4,135 | 4,097 | 3,648 |
| Largest number borrowed on any day | 40 | 42 | 42 | 41 | 46 | 41 | 30 | 60 | 35 | 37 |
| Average number borrowed daily | 16 | 18 | 23 | 16 | 15 | 16 | 13 | 13 | 13 | 11 |
| Largest number borrowed in any month | 564 | 579 | 734 | 623 | 481 | 613 | 458 | 480 | 436 | 431 |
| Average number borrowed monthly | 432 | 460 | 571 | 507 | 396 | 424 | 346 | 344 | 341 | 304 |

## APPENDIX 5.

### ACCESSIONS.

The total number of catalogued books, pamphlets, and maps added to the library during the year was 9,258, a decrease of 1,412 as compared with the catalogued accessions of the previous year. Detailed statistics of the accessions of the past five years are given in the following table:

*Accessions to the library for the fiscal years 1914 to 1923.*

| Accessions. | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Purchases: | | | | | | | | | | |
| Volumes | 1,548 | 1,353 | 1,595 | 1,949 | 1,510 | 1,373 | 1,989 | 1,420 | 1,384 | 2,040 |
| Pamphlets | 41 | 39 | 49 | 76 | 79 | 88 | 119 | 47 | 81 | 94 |
| Maps and charts | 1 | ..... | 13 | 1 | 4 | 2 | 6 | 3 | 9 | 13 |
| Serials and continuations | 511 | 376 | 274 | 147 | 97 | 154 | 187 | 456 | 464 | 300 |
| Total | 2,101 | 1,768 | 1,931 | 2,168 | 1,690 | 1,617 | 2,301 | 1,926 | 1,938 | 2,447 |
| Gifts: | | | | | | | | | | |
| Volumes | 719 | 780 | 873 | 641 | 676 | 647 | 768 | 774 | 934 | 720 |
| Pamphlets | 470 | 500 | 397 | 508 | 642 | 371 | 580 | 492 | 751 | 847 |
| Maps and charts | 20 | 22 | 18 | 4 | 59 | 15 | 21 | 10 | 59 | 15 |
| Continuations | 4,490 | 4,909 | 4,919 | 4,458 | 3,807 | 2,647 | 4,762 | 3,515 | 5,683 | 3,684 |
| Total | 5,699 | 6,211 | 6,207 | 5,611 | 5,184 | 3,680 | 6,131 | 4,791 | 7,427 | 5,266 |
| From binding periodicals and serials | 1,826 | 1,085 | 1,612 | 1,178 | 949 | 748 | 1,161 | 768 | 1,305 | 1,545 |
| Total | 9,626 | 9,064 | 9,750 | 8,957 | 7,823 | 6,045 | 9,593 | 7,485 | 10,670 | 9,258 |

According to the record of accessions the total number of books and pamphlets accessioned by the library up to July 1, 1923, was 175,168. From this number should be taken 5,910 which were discarded during the fiscal year 1915 and 790 which have been discarded since that time, leaving a balance of 168,468 accessioned volumes and pamphlets in the library on July 1, 1923.

## APPENDIX 6.

### CATALOGUING.

The record of the material catalogued during the past five years is as follows:

| | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Volumes | 2,020 | 2,757 | 2,194 | 2,318 | 2,760 |
| Pamphlets | 459 | 699 | 539 | 832 | 941 |
| Maps | 17 | 27 | 13 | 68 | 28 |
| Serials and continuations | 3,549 | 6,110 | 4,739 | 7,452 | 3,984 |
| Total | 6,045 | 9,593 | 7,485 | 10,670 | 7,713 |
| Pamphlets [1] | 273 | 501 | 96 | 229 | 87 |
| "Reprints" [2] | 2,498 | 1,937 | 4,828 | 2,745 | 1,502 |

[1] Not fully catalogued. [2] Author cards only.

*Uncatalogued material.*

| | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Volumes | 368 | 274 | 290 | 543 | 1,262 |
| Pamphlets | 648 | 599 | 1,085 | 1,905 | 798 |
| Continuations | 943 | 540 | 1,105 | 846 | 1,541 |
| Maps | 6 | 7 | ..... | 19 | 43 |

*Number of titles prepared for printing by the Library of Congress in the "Agr." series.*

| | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Cards for accessions and recatalogued books | 512 | 817 | 1,097 | 786 | 599 |
| Cards for department pubications | 656 | 611 | 627 | 369 | 381 |
| Cards for foreign agricultural periodicals | ..... | ..... | ..... | ..... | 263 |
| Total | 1,168 | 1,428 | 1,724 | 1,155 | 1,243 |

*Record of cards added to the catalogue.*

| | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Number of cards added | 21,881 | 21,504 | 23,730 | 17,148 | 24,728 |
| Number of cards withdrawn | 3,118 | 2,353 | 4,224 | 1,739 | 2,752 |
| Net addition to catalogue | 18,763 | 19,151 | 19,506 | 15,409 | 21,976 |

## APPENDIX 7.

### PERIODICALS.

| | |
|---|---|
| Number of different periodicals currently received by purchase | 974 |
| Number of different periodicals currently received by gift and exchange | 2,277 |
| Total number of different periodicals received | 3,251 |
| Number of additional copies purchased | 253 |
| Number of additional copies received by gift and exchange | 230 |
| Total number of periodicals purchased, including duplicates | 1,227 |
| Total number of periodicals received by gift and exchange, including duplicates | 2,507 |
| Grand total of periodicals received currently, including duplicates | 3,734 |

The average number of current periodicals received daily during May and June, 1923, was 234; during April and May, 1922, 302; during the same period in 1921, 268. The decrease in the number received in the department library is probably largely due to the fact that daily papers and most of the duplicate copies are now addressed by the publishers to the bureaus desiring them, instead of coming first to the department library.

## APPENDIX 8.

### BINDING.

| | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Number of books sent to bindery | 2,019 | 1,866 | 1,821 | 2,858 | 1,417 |
| Number of volumes placed in temporary binders | 1,612 | 1,000 | 1,152 | 1,059 | 1,762 |
| Pamphlets stapled in binders | 743 | 894 | 622 | 675 | 692 |

Approximately 5,000 current numbers of periodicals, bulletins, and reports were also added to the files already in temporary binders. Owing to pressure of other work, it was found impracticable to do this work as systematically as formerly. Therefore, only the publications of this department and of the State agricultural experiment stations have been laced regularly into binders, and numbers of most other series have been sent to the shelves until several have accumulated. This has reduced the work, but does not keep the shelves in as good condition or protect the publications adequately.

## APPENDIX 9.

*Expenditures for Library printing and binding for the fiscal years 1919 to 1923.*

| Item. | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|
| Regular binding | $2,734.23 | $8,255.30 | $5,537.74 | [1] $12,723.58 | $5,250.13 |
| Binders | 1,641.23 | 606.84 | 1,151.12 | ([2]) | 663.10 |
| Pamphlet boxes | 330.00 | | | | |
| Forms | 247.82 | 259.38 | 241.64 | 303.26 | 318.76 |
| Publications | 400.36 | 84.30 | 94.61 | 889.17 | 73.36 |
| Index cards | | | | 578.27 | 157.12 |
| Miscellaneous | 4.57 | 4.88 | 6.09 | 55.31 | 14.02 |
| Total | 5,358.21 | 9,210.70 | 7,031.20 | 14,549.59 | 6,476.49 |

[1] Includes regular binding and binders.
[2] Separate figures not available; included with regular binding.

## APPENDIX 10.

*Financial statement, fiscal years 1914 to 1923.*

RECEIPTS.

| Fiscal year. | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 |
|---|---|---|---|---|---|---|---|---|---|---|
| Source: | | | | | | | | | | |
| Library appropriation | $43,520.00 | $45,360.00 | $46,020.00 | $49,520.00 | $50,160.00 | $50,160.00 | $50,160.00 | $54,880.00 | $51,460.00 | $57,660.00 |
| From department printing and binding fund | 11,345.84 | 10,190.62 | 9,662.12 | 8,707.52 | 12,068.38 | 5,358.21 | 9,210.70 | 7,031.20 | 14,549.59 | 6,476.49 |
| Total | 54,865.84 | 55,550.62 | 55,682.12 | 58,227.52 | 62,228.38 | 55,518.21 | 59,370.70 | 61,911.20 | 66,000.59 | 64,136.49 |

EXPENDITURES.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Books and serials | $9,083.69 | $8,300.90 | $8,840.89 | $8,975.89 | $7,257.40 | $7,186.86 | $9,246.05 | $9,411.58 | $9,864.86 | $10,791.79 |
| Periodicals | 4,233.41 | 3,586.17 | 3,978.46 | 4,093.62 | 4,252.74 | 6,139.99 | 5,231.48 | 6,039.62 | 6,323.37 | 6,932 58 |
| Maps | 47.50 | .40 | | 215.00 | 40.88 | .70 | 62.04 | | | |
| Index cards | 174.03 | 194.88 | 169.59 | 129.07 | 78.86 | 85.25 | 112.23 | 178.51 | 141.88 | 139.63 |
| Furniture, shelving, and miscellaneous equipment | 769.37 | 3,148.23 | 866.85 | 552.26 | 765.88 | 604.04 | 293.16 | 2,525.94 | 29.91 | 2,435.20 |
| Traveling expenses | | | 31.20 | | | 179.44 | 48.52 | 219.72 | 190.23 | 177.52 |
| Freight, express, and drayage | | | | 10.62 | 16.24 | 37.75 | 93.07 | 56.94 | 54.10 | 13.95 |
| Supplies and repairs | 323.42 | 350.00 | 429.16 | 469.24 | 981.33 | 609.01 | 539.58 | 518.50 | 566.76 | 1,458.22 |
| Truck service | | | | | | | | 9.87 | | 52.78 |
| Salaries (main library) | 28,377.29 | 29,585.50 | 31,278.06 | 33,025.53 | 33,272.25 | 31,440.95 | 31,462.85 | 29,934.60 | 33,990.63 | 34,613 39 |
| Newspapers | | | | | | | | | | 94.16 |
| Total | 43,008.71 | 45,166.08 | 45,594.21 | 47,471.23 | 46,665.58 | 46,283.99 | 47,088.98 | 48,885.41 | 51,171.61 | 56,709.22 |
| Printing | 1,892.25 | 1,895.47 | 1,806 79 | 1,727.17 | 1,576.78 | 652.75 | 348.56 | 342.34 | 1,826.01 | 565.53 |
| Binding | 9,453.59 | 8,295.15 | 7,855.33 | 6,980.35 | 10,491.60 | 4,705.46 | 8,862.14 | 6,688.86 | 12,723.58 | 5,910.96 |
| Grand total | 54,354.55 | 55,356.70 | 55,256.33 | 56,178.75 | 58,733.96 | 51,642.20 | 56,299.68 | 55,916 61 | 65,721.20 | 63,185.71 |

NOTE. In addition to the salaries provided for by its own appropriations, the library has for several years had the assistance of the bureaus in the payment of salaries of assistants detailed to the library. During the fiscal year 1923 salaries to the amount of $10,319.86 were thus carried.

# REPORT OF THE DIRECTOR OF THE STATES RELATIONS SERVICE.

UNITED STATES DEPARTMENT OF AGRICULTURE,
STATES RELATIONS SERVICE,
*Washington, D. C., June 30, 1923.*

SIR: I have the honor to present herewith the report of the States Relations Service for the fiscal year ended June 30, 1923.

A. C. TRUE, *Director.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## INTRODUCTION.

With the end of the current fiscal year, June 30, 1923, the States Relations Service will cease to exist and its several offices will have new relations to the organization of the Department of Agriculture. It therefore seems fitting that this final report of the Director of the States Relations Service should contain a brief history of the work which has been under his direction for the past 30 years, together with reference to earlier matters which led to the inauguration of this work.

## THE MOVEMENT FOR AGRICULTURAL RESEARCH IN THE UNITED STATES.

In 1862 the land-grant act, providing endowment for agricultural colleges, and the act establishing the Department of Agriculture brought to a definite head on a national basis a movement for the application of science to agricultural problems through research, instruction, and dissemination of information which had been slowly growing in the United States for more than half a century.

As soon as agricultural colleges were organized they began in a small way to carry on experiments. The agricultural branch of the Patent Office had for a number of years previous to 1862 made studies in chemistry, botany, entomology, and plant production. The chemical studies and field experiments at Rothamsted, England, and in France, together with the organization of experiment stations in Germany as public institutions, made an increasing impression on friends of agricultural improvement in this country. The establishment of the Bussey Institution by Harvard College in 1870 and its early experiments, the similar activities of the California College of Agriculture and by Prof. S. W. Johnson at Yale College,

and the use of the grounds now occupied by the Department of Agriculture as an experiment farm, together with its scientific investigations, served to stimulate nation-wide interest in such work.

At length, in 1875, there was the definite establishment of an experiment station after the German plan in Connecticut and about the same time in California. A number of States very soon followed these examples, and the agricultural colleges and some farmers began to urge Federal appropriations for experiment stations. The first bill for this purpose was introduced in Congress in 1883 and after four years of agitation the Hatch Act was passed in 1887.

Meanwhile the Association of American Agricultural Colleges and Experiment Stations had been formed and with the cooperation of the United States Commissioner of Agriculture had advocated the establishment in the Department of Agriculture of an office to promote the general interests of the stations. This was provided for in general terms in the Hatch Act, as follows:

> SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner (now Secretary) of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiment; to indicate from time to time such lines of inquiry as to him shall seem most important, and, in general, to furnish such advice and assistance as will best promote the purpose of this act.

The first appropriation under the Hatch Act was carried in the appropriation act of the department for 1888–89, together with an item of $10,000 for the Federal work called for in the Hatch Act.

## THE OFFICE OF EXPERIMENT STATIONS.

By order of Commissioner Colman the Office of Experiment Stations was established in the Department of Agriculture October 1, 1888. Dr. W. O. Atwater, professor of chemistry in Wesleyan University, who had been director of the first experiment station established in Connecticut, was appointed Director of the Office of Experiment Stations, with the understanding that he would give two-thirds of his time to this work. A. W. Harris was appointed assistant director, and Miss S. L. Sommers was transferred from the War Department as clerk.

In November, Dr. A. C. True joined this force under a temporary commission from the Government board for the Paris Exposition of 1889 to prepare a small exhibit of photographs and a report on the agricultural colleges and experiment stations for that exposition. On March 3, 1889, he became a member of the staff in an editorial capacity as the result of a civil-service examination.

Immediately after its establishment, the Office of Experiment Stations began to assemble information regarding the organization, revenues, work, equipment, and publications of the agricultural colleges and experiment stations. An address list of the stations was soon published, and this was followed by an organization list, which was developed to include both college and station. This has been issued annually up to the present year. An effort was made to collect station publications, and this has been systematically continued, with the result that the office has the most complete set of these publications from their beginning to the present day.

The report of the Office of Experiment Stations for 1888 states that "farmers' bulletins" and technical monographs on special lines of research had been planned and begun. The farmers' bulletins were to contain "the results of station work bearing upon special topics and the teachings of other research and put the whole into a form so plain that the intelligent farmer will understand it, so brief that he will read it through, and so practical that he will take it to heart."

The report also quotes with approval from a report of the committee on station work of the Association of American Agricultural Colleges and Experiment Stations, in which the functions of the stations are outlined. In this report it is pointed out that while the stations should carry on practical experiments the results of which may "directly and immediately help the farmer," they should also conduct more fundamental research, for "the prosperity of the enterprises as a whole will be proportioned to its success in the discovering of the laws that underlie the right practice of agriculture." The committee also urged that it is—

> A part of the duty of the stations to teach, but to teach only well-attested and useful facts. By publishing information in terse, simple language, with appropriate explanations, by attending farmers' meetings, and demonstrating in lectures and otherwise the things farmers need and desire to know; by interesting farmers in experimental work, and securing their cooperation in carrying it out; in short, by diligent effort to carry knowledge to the farmer and help him with it, and at the same time help him to help himself, the workers in the stations will both do their duty and secure the support they need.

The broad program thus outlined for the stations undoubtedly was intended to meet the situation under which they began their work under the Hatch Act when the agricultural colleges, of which with few exceptions the stations were departments, were for the most part weak institutions with few agricultural students and with practically no funds for extension work. The differentiation of the functions of these institutions as regards research, teaching, and extension work with which we are now so familiar had hardly been thought of or begun. The coming of the Hatch funds made possible the immediate expansion of the faculties of the agricultural colleges. The station workers needed to become acquainted with the agricultural students and the farming people whose problems they were to attempt to solve. It was natural, therefore, to give these experimenters duties also as teachers and extension workers. In this way they immediately did much useful work and secured a large measure of popular support, but at large sacrifice of research and with the arousing of expectations which they could not fulfill as long as they attempted to cover so broad a field.

### DEVELOPMENT OF PUBLICATIONS.

During the first five years the principal work of the Office of Experiment Stations was the organization and development of its publications. The early preparation of a digest of the annual reports of the stations for 1888, which contained a summary of the beginnings of station work under the Hatch Act, with many references to earlier work in a number of States, opened the way for a serial publication to record continuously their progress in research.

In 1889 the first number of Experiment Station Record was prepared. This contained abstracts of the publications of the stations in 13 States (Alabama to Kansas) arranged by States in alphabetical order, lists of publications of the department and the stations, and brief editorial notes. The arrangement of abstracts by States was recognized as not ideal, but was adopted because at that time it was deemed quite important to emphasize the fact that the stations were distinct departments of the colleges or separate institutions having a definite organization for experimental work. In other words, this helped to put the stations "on the map." This arrangement was continued through three volumes. Thereafter the abstracts have been arranged by subjects under a number of the main divisions of agricultural science. In the third number of the first volume abstracts of department publications were added, and in the fourth number a beginning of recognition of the foreign stations was made by the publication of statistics of the German stations. The first volume also contains name and subject indexes.

In 1890 Dr. E. W. Allen joined the staff of the office, followed by W. H. Beal early in 1891. This permitted a large expansion of the Record in its second volume and the introduction of abstracts of Canadian and European experiments, together with news notes about the stations. It is probably difficult for present readers of Experiment Station Record to realize how conservative the department was at the outset in undertaking the inclusion of abstracts of foreign publications in the Record. There were many doubts as to whether it had authority to do such work or whether it would be acceptable to Congress and the public.

In 1889 the first of a series of popular bulletins relating to experiment station work was published. There was much thought given to the choice of a name for this series before the title of "Farmers' Bulletin" was adopted. The first of these bulletins, under the title of "The what and why of agricultural experiment stations," gave a brief explanation of the purpose, history, work, and publications of the stations and an address list of the State stations. This was followed in the second number by brief summaries of station work in several lines. These bulletins proved so acceptable to the public that the Secretary of Agriculture made the series general for the department, and thereafter they have been prepared by the various bureaus of the department, though for a number of years the Office of Experiment Stations was the most frequent contributor to the series. From 1897 to 1913 the office also contributed to the Farmers' Bulletin series 76 numbers of a subseries entitled "Experiment station work," each number of which contained several brief popular articles based upon the more practical work of the experiment stations and kindred institutions in this and other countries.

In 1890 the card index of station publications was begun and in 1892 a handbook of experiment station work was prepared. In 1889 the office began the editing and publication of the proceedings of the Association of American Agricultural Colleges and Experiment Stations, which was continued through 1909, when the association itself undertook this work.

A large number of technical bulletins on subjects relating to the work of the Office of Experiment Stations and the States Relations

Service have been published. Among these are the large monographs on the chemical composition of American food materials (Bulletin 28), first published in 1896 and repeatedly revised since; the cotton plant (Bulletin 33), published in 1896; a digest of metabolism experiments with men and domestic animals (Bulletin 45), published in 1897; and the history of the agricultural experiment stations up to 1900 (Bulletin 80).

### DEVELOPMENT OF RELATIONS WITH THE STATIONS.

The Hatch Act made no provision for Federal administration of the funds granted to the stations beyond the requirement that each station should annually make "a full and detailed report of its operations, including a statement of receipts and expenditures," to the governor of the State or Territory, a copy of which was to be sent to the Commissioner (now Secretary) of Agriculture and to the Secretary of the Treasury. There was much variety of opinion among governing boards and administrative officers in the States regarding the proper functions of agricultural experiment stations. Particularly the phrase used in the first section of the Hatch Act with reference to "diffusing among the people of the United States useful and practical information on subjects connected with agriculture" was often interpreted to permit station officers to engage in teaching or extension work or to carry on substations or cooperative work with farmers in which the experimental fields were little more than demonstration farms. Allegations of diversion or looseness in the expenditure of the Federal funds came from time to time to the department. These attracted the attention of J. Sterling Morton in the early days of his administration as Secretary of Agriculture. He therefore appealed to Congress for authority to inquire into the expenditure of the Hatch funds. The result was that in the appropriation act for the department for the fiscal year 1894 and each succeeding year there has been a provision that the Secretary of Agriculture shall prescribe the form of the annual financial statement of the stations required in the Hatch Act, shall ascertain whether the expenditures have been in accordance with the provisions of that act, and shall make report thereon to Congress. Under this authority the Office of Experiment Stations began in 1894 to make an annual inspection of the station work and expenditures in each State.

It was determined at the outset not to employ special officers as inspectors, but to have this duty performed by the director of the office and his principal scientific assistants, who were constantly following the publications of the stations in connection with the preparation of Experiment Station Record. At first only the director and assistant director engaged in this work and thereafter were assisted by only two or three of the most experienced members of the staff. This enabled the pursuance of a consistent policy of administration and brought the office a thorough acquaintance with the conditions, requirements, and needs of the several stations.

The examination of accounts became only a small part of the business transacted during visitations of the stations. These visits have been very largely conferences with administrative officers and the scientific staff of the station regarding their lines of work, ma-

terial equipment, personnel, publications, financial needs, obstacles, means of reaching the farmers, and various other matters. A sympathetic and helpful attitude has been assumed by the visitors. Much useful information has been given the station workers, and the requirements of station work have often been impressed on administrative officers, governing boards, and sometimes on governors and legislatures. Standards of work and expenditures have been set up as the result of intimate acquaintance with conditions existing throughout the United States. A progressive policy has been pursued with reference to strictness of legal interpretations and the attitude toward different lines of work.

For a considerable time after the establishment of the stations there was a great lack of properly trained investigators, particularly in the more purely agricultural lines of work which appealed particularly to the farmers. It was therefore necessary for the stations to make many comparatively simple experiments and to employ unusual methods to disseminate the results of their work so as to win the support of the farmers. It was also necessary to take a liberal attitude toward the assistance which station officers gave to the teaching departments of the colleges, since the strengthening of the agricultural instruction was imperative if there were to be well-trained investigators.

On the other hand, it was very important that the unity of organization of the station within the college should be maintained, that station workers should have time and means to do real experimental work, that station funds should not be wasted in trivial or unproductive enterprises, and that the tendency to scatter these funds over the State in substations or otherwise should be checked, lest the whole station enterprise should be structurally weak. The office therefore exerted constant pressure in these directions with results which greatly strengthened the stations.

When it became apparent that the stations needed more financial aid from the Federal Government than was given in the Hatch Act, the Office of Experiment Stations joined with those who believed that such aid should be given to strengthen the more fundamental investigations of the stations. This movement resulted in the passage of the Adams Act in 1906, with the provision that the use of the funds granted under that act should be restricted to "original researches or experiments." In administering this act the office has arranged with the stations for the submission of their projects before putting them into effect. This has given opportunity for much helpful consultation on these projects and a large amount of relatively fundamental and thorough research has been carried on by the stations in recent years.

The functions of the office as a clearing house of information and consultation on a great variety of matters relating to agricultural research throughout the world have steadily grown and have given it an important place in aiding the scientific work of the department and the stations.

### THE ALASKAN AND INSULAR STATIONS.

Growing interest in Alaska led Congress to make an appropriation in 1897 for experimental work in agriculture in that Territory.

A station was established at Sitka and subsidiary stations have since been maintained at Kenai (transferred to Kodiak in 1908), Copper Center (transferred to Fairbanks in 1908), Rampart, Fairbanks, Matanuska, and on Kodiak Island. C. C. Georgeson has been in immediate charge of all the Alaska work since the beginning, and Walter H. Evans, who joined the Washington force of the Office of Experiment Stations in 1892, has represented that office in the general supervision of this enterprise.

Through extensive travel of station officers, reports by settlers on their use of seeds distributed by the stations and on their other agricultural operations, and a large amount of experimental work with plants and animals, great progress has been made in determining the agricultural possibilities of this vast Territory. Much has also been done in selecting and breeding varieties of plants adapted to the soil and climatic conditions in different parts of Alaska. Experiments with animals have also shown much regarding their breeding, care, and management as related to Alaskan conditions. It has been demonstrated that wheat, oats, barley, potatoes, and many kinds of vegetables of good quality can be grown in different parts of the Territory. Numerous gardens in many places now regularly furnish settlers goodly contributions to their food supply and a considerable number of farmers and horticulturists are carrying on larger agricultural operations. A basis has thus been laid by the station work for considerable agriculture in Alaska when the growth of mining, lumbering, and other industries encourages a sufficiently large influx of farming people.

Stations under the management of the Office of Experiment Stations were established in Hawaii and Porto Rico in 1901 and in Guam in 1908. A station maintained by the Danish Government in the Virgin Islands was taken over when those islands were transferred to the United States in 1918. All these insular stations, under the supervision of Doctor Evans, have done much to diversify and improve the tropical agriculture and horticulture of the islands and have disseminated much useful information among their people through publications and extension work.

Among the greater accomplishments of the insular experiment stations have been the introduction and establishment of many improved forage plants as an essential to livestock improvement in the islands. The stations have also led in the introduction of purebred animals, with the result that the effect of the better blood is becoming widely evident.

The Hawaii station found that a disease which was doing great damage to pineapples was due to excessive amounts of manganese in the soil, and showed that spraying the plants with a solution of iron sulphate corrects the trouble. These discoveries of the station made possible the replanting of more than 10,000 acres on which pineapple growing had been abandoned because of the disease. This station has also shown the value of cover crops in the Tropics and of rotations for sugar cane and pineapples, the leading crops of Hawaii, and has been instrumental in widely extending their use. The superiority of ammonium sulphate over nitrate of soda for fertilizing rice is another important result of the work of this station.

The Porto Rico station has demonstrated the practicability of controlling cattle ticks through the use of dipping tanks, and there are now more than 100 public and private tanks in the island. Following the control of ticks and with the introduction of improved forage plants, the livestock industry has developed rapidly, and dairying has become an actuality. The station led in the investigations which made these developments possible. The station has assisted very materially in the development of the citrus industry of the island, established vanilla growing as a profitable undertaking, and introduced Uba sugar cane, which is resistant to the mosaic disease and is now extensively planted.

In Guam the demonstration of modern methods of agriculture and the introduction of improved varieties of crops and purebred livestock by the station have greatly improved the agricultural situation of the island, and stock raising, as an industry, has become established. As a result of the station's investigations it is now possible for the people of Guam to produce a better quality and a larger quantity of copra, for which an enhanced price is obtained.

Sugar-cane breeding has been an outstanding feature of the work of the Virgin Islands station, and a variety has been developed that not only outyields any of the varieties that are grown locally, but has proved its high value when tested in several other countries.

### THE NUTRITION INVESTIGATIONS.

As the work of the Office of Experiment Stations in its relations with the State experiment stations touched lines of work for which the Department of Agriculture had at the time no organization, there was for a number of years a growing tendency to put under that office special investigations for which Congress provided funds. The first of such investigations to come to this office was that which dealt with human nutrition.

This work grew out of the studies which were being made at Wesleyan University, Middletown, Conn., in conjunction with the Storrs Experiment Station. The results of these studies had attracted the attention of Hon. Edward Atkinson, of Boston, Mass., who had compiled data on this subject from foreign sources and had been interested in the experimental and practical work of the New England Kitchen, in that city, conducted by Mrs. Ellen H. Richards, with the collaboration of the Massachusetts Institute of Technology. Mr. Atkinson prepared a paper containing "Suggestions for the establishment of food laboratories in connection with the agricultural experiment stations," which was published as Bulletin 17 of the Office of Experiment Stations. Secretary Morton became interested in this matter and asked Congress for an appropriation for nutrition investigations, which was granted for the fiscal year 1894.

The supervision of this work was assigned to the Office of Experiment Stations and Professor Atwater was put in charge, with headquarters at Middletown. For a number of years the work was carried on in cooperation with Wesleyan University and Storrs Experiment Station in Connecticut and with colleges, experiment stations, and other institutions in many States. It consisted of the collection of information regarding the foods available and their uses in dif-

ferent regions; dietary studies among rural and urban people; digestion and metabolism experiments; experiments on the nutritive value and cost of diff rent rations; the effect of cooking on composition, digestibility, and nutritive value of foods; the compilation on a broad scale of analyses and experiments in this country and abroad; and the improvement of methods and apparatus for nutrition work.

One very important enterprise in which the department aided was the completion and use of the respiration calorimeter devised by Professors Atwater and Rosa. The nutrition investigations continued to grow in interest and value as part of the work of the Office of Experiment Stations for over 20 years. A large number of technical publications were issued, together with numerous farmers' bulletins, some of which had very wide circulation. Special efforts were made to bring the results of this work to the attention of colleges and schools. Much use was made of the department publications on this subject in educational and other institutions. The information they contained was also widely incorporated in textbooks and manuals published in this and other countries.

In 1907 the laboratory equipment at Middletown was removed to Washington and installed in a Government building, and the nutrition investigations were continued here under the direction of Dr. C. F. Langworthy.

### OFFICE OF HOME ECONOMICS.

In 1915, when the States Relations Service was organized, the nutrition investigations were expanded to form the Office of Home Economics as a part of that service. Doctor Langworthy was appointed chief, and a larger staff, increased appropriations, and additional laboratory and office space have followed, which have made possible a broader program and a greater output. The work, as defined in appropriation acts, has covered investigations of the relative utility and economy of agricultural products when used for food, clothing, or other purposes in the home. Some studies on household equipment and management have also been made. Experimental studies of practical and technical problems have been made by appropriate laboratory methods, some of them especially adapted or devised for particular work. There have also been the collection and interpretation of statistical data regarding food consumption of individuals and families and studies of household labor and of household management. The respiration calorimeter as an instrument of precision has been shown to be well adapted to the study of a wide range of agricultural problems, in addition to those specially concerned with the home.

The dietary-survey methods with individuals and families have been developed into a nation-wide dietary survey, a result of wartime need for definite information of this character. The machinery for carrying on such surveys has been perfected and includes cooperative features within the department and with agricultural colleges which increase its usefulness out of proportion to the cost involved. Such surveys furnish per capita consumption data hitherto lacking and other information essential to agricultural production intelligently adjusted to the people's needs. Such surveys can and should be extended to include clothing, equipment, etc., as well as

food, in order that production and consumption in general may be considered on the basis of information much needed but now lacking and other important economic problems furthered.

The development and extension of earlier work on food preparation and use have resulted in an "experimental kitchen," well provided with physical and chemical apparatus, as well as household equipment, where a great variety of problems have been studied. A feature of this work has been the development of cooperation with home-economics workers in agricultural and other colleges.

A plan has been devised for determining proper food selection in such a way that any housekeeper may feel sure that the food she provides her family will meet their needs. This generalization can be so simply expressed that anyone can understand and apply it. On the other hand, it is so fundamental in its nature that it proves equally useful for advanced teaching and for technical discussions.

More than a beginning has been made in work on clothing and household equipment, with the result that several bulletins have been published, and material accumulated for others includes results of tests as well as some generalizations.

### IRRIGATION INVESTIGATIONS.

With the spread of irrigation in the Western States during the second half of the nineteenth century many problems arose regarding available water supply, water rights, control of appropriation and distribution of water, methods of irrigation, amounts of water required for different crops, and the like. The Geological Survey was given authority to study the problems of water supply and storage, and issued numerous publications on these subjects. The experiment stations in the States where irrigation was practiced collected information and made experiments on agricultural problems connected with irrigation. In several States irrigation engineers' offices were established to administer State laws relating to irrigation and collected considerable information bearing on legal and regulatory problems.

In the appropriation act of the Department of Agriculture for the fiscal year 1893 was an item of $6,000 for "the collection of information as to the best modes of agriculture by irrigation." This appropriation was continued for three years and was raised to $15,000 for 1896 but discontinued the next year. An office of irrigation inquiry was established. Department agents visited the Western States and collected information which was published in various ways. Among these publications were articles on "Irrigation in California" in the Yearbook for 1895, and "Irrigation on the Great Plains" in that for 1896. Irrigation had been practiced for many years in the Eastern States on a limited scale, especially on grasslands, and the success of irrigation in the West led to attempts to use this aid to agriculture more largely in the humid regions, particularly with garden and truck crops. The Yearbook for 1895 contains an article by L. R. Taft, of the Michigan Agricultural College, on "Irrigation for garden and greenhouse."

The Office of Experiment Stations had from its beginning published in Experiment Station Record abstracts of the publications of the experiment stations bearing on irrigation.

In 1896 this office was called upon to extend its work relating to irrigation. Under its supervision were prepared Farmers' Bulletin 46, "Irrigation in humid climates," by Prof. F. H. King, of the Wisconsin College of Agriculture, who had studied irrigation practices in several European countries in 1895; Department Bulletin 36, "Notes on irrigation in Connecticut and New Jersey," by C. S. Phelps and E. B. Voorhees.

Increasing need for wider investigation of the legal, administrative, and agricultural problems relating to irrigation led to an appeal from interested parties in the Western States to Congress for an appropriation for this purpose. In the appropriation act for the department for the fiscal year beginning July 1, 1898, was included an item of $10,000 for "collecting from agricultural colleges, experiment stations, and other sources, including the employment of practical agents, valuable information and data on the subject of irrigation, and publishing the same in bulletin form." By order of Secretary Wilson, supervision of this work was assigned to the Office of Experiment Stations.

To aid in determining the lines of work to be conducted, a conference was held at Denver, July 12 and 13, 1898, which was attended by experiment station officers and irrigation engineers from six Western States, together with the director and Mr. Beal, of the Office of Experiment Stations. After careful consideration it was decided to confine the work of the office on irrigation to (1) the collation and publication of information regarding the laws and institutions of the irrigated region in their relation to agriculture, and (2) the publication of available information regarding the use of irrigation waters in agriculture as determined by actual experience of farmers and experimental investigations, and the encouragement of further investigations in this line by the experiment stations.

Elwood Mead, State engineer of Wyoming, was selected to have immediate charge of this work, with headquarters at Cheyenne, Wyo., which were afterwards transferred to Washington. Studies of laws and water rights were immediately begun and plans were made for cooperative investigations on the duty of water and other subjects. So much interest was aroused in this matter that Congress at its next session increased the appropriation to $35,000, of which $10,000 was made immediately available, and the language of the appropriation act was changed to provide for investigations and reports "upon the laws and institutions relating to irrigation and upon the use of irrigation waters, with special suggestions of better methods for the utilization of irrigation waters in agriculture than those in common use," and for cooperation of the experiment stations in this work. On this broader and more permanent basis irrigation investigations were conducted by the Office of Experiment Stations for 16 years, until they were transferred to the Office of Public Roads in 1915, where they have since been continued. Doctor Mead resigned in 1907 to take charge of similar work in Australia and was succeeded by Dr. Samuel Fortier, who had been in charge of the work in California.

The passage of the reclamation act in 1902 and the consequent great activity of the Government in the construction of large irrigation works in the Western States greatly stimulated public interest

in the use of water for irrigation and gave increased importance to the irrigation studies of the Office of Experiment Stations.

At the outset the chief effort was made on what was then the most urgent problem of the irrigated region in the West, namely, the reform of the legislation relating to irrigation in the several States. Largely through the studies and efforts of the Office of Experiment Stations improved legislation was enacted in the arid States and the general principle of determining water rights according to the actual and beneficial use of water was firmly established.

Next in importance was the need of more economical use of the limited supplies of water available for irrigation. Therefore, studies to determine, first, how much water was being used, and then how much should be used, and how economical use could be secured under varying conditions and with different crops, have been a leading line of investigation. Much of this work was done in cooperation with the State experiment stations. Devices for measuring water were tested and new devices were developed. Studies of losses of water in transit from stream to farm led to improvement in conduits and the saving of much water. Much was also done to promote water contracts and regulations which would encourage the economical use of water. Numerous technical and popular publications were issued, and the results of the irrigation investigations have been incorporated in textbooks and manuals.

### DRAINAGE INVESTIGATIONS.

In the earlier development of irrigation in the West the thoughts of settlers were so largely concentrated on securing a water supply and its application to crops that they generally overlooked the necessity of making provision for drainage until the appearance of alkali or other troubles menaced their crops.

Realizing the danger to agriculture under irrigation from lack of drainage, the Office of Experiment Stations gave attention to this subject from the beginning of its irrigation investigations. Interest in drainage was thus stimulated in the West. Meanwhile the broad discussion of land reclamation by irrigation which preceded the passage of the reclamation act led also to much greater public interest in reclamation by drainage, for which there was ample opportunity in many localities in the humid region.

Thus it came to pass that in 1902 C. G. Elliott, an experienced drainage engineer and author of Farmers' Bulletin 40, on farm drainage, published in 1896, was added to the irrigation force in the Office of Experiment Stations. Under his leadership work relating to drainage was greatly expanded and in 1907 was made a separate division of the office and thus continued until 1915, when it was transferred to the Office of Public Roads.

During this period of 13 years much progress was made toward a better understanding and solution of the problems of drainage of irrigated lands injured by seepage and alkali and toward the wider use of tile drainage, especially in the Southern States. A broader accomplishment was the surveying and planning of drainage systems, often on a large scale, which involved community effort and the formation of drainage districts. In at least eight States general laws for the establishment of drainage districts and for financing

these districts through the issuance of bonds were enacted, largely as a result of the information acquired and disseminated by our drainage engineers. Under these laws hundreds of drainage districts were formed during the period of the investigations and hundreds of thousands of acres of swamp and overflowed lands were reclaimed.

### OTHER STUDIES IN RURAL ENGINEERING.

In connection with the irrigation and drainage investigations considerable attention was given to studies of the machinery required in these lines of agricultural work, including pumps, windmills, devices for measuring and applying water, machines for digging and cleaning drainage ditches, and the like. Encouragement and assistance were also given to the agricultural colleges which were beginning to organize more definite courses relating to farm machinery, buildings, and other subjects connected with rural engineering.

In 1907 an expert in farm machinery was employed in the Office of Experiment Stations and an attempt was made to inaugurate studies which it was hoped might lead to the improvement and standardization of the machines used on farms. The time was apparently not ripe for creating a permanent Federal agency for such work and the pressure of other enterprises led to its discontinuance after a year's trial.

### AGRICULTURAL EDUCATION.

From its beginning the Department of Agriculture has shown an interest in agricultural education. Some of its early reports gave accounts of institutions for agricultural education at home and abroad. The meetings of representatives of the agricultural colleges called by the Commissioner of Agriculture, Norman J. Colman, which led to the organization of the Association of American Agricultural Colleges and Experiment Stations and the passage of the Hatch Act, brought about a broader relation of the department to the cause of agricultural education. It was therefore natural that when the Office of Experiment Stations was established it should be encouraged to aid in a general way the colleges with which the stations were connected.

As already stated (p. 554), one of the first pieces of work committed to this office was the preparation of an exhibit and report on agricultural education in the United States. The Morrill Act of 1890 provided that copies of the annual reports of the agricultural colleges should be sent to the Department of Agriculture. When these were received they were intrusted to the Office of Experiment Stations. Thus a foundation was laid for the systematic collection and dissemination of information regarding these institutions. Representatives of the office regularly attended the meetings of the association of agricultural colleges, and that office undertook the editing and publication of the proceedings of the association, beginning in 1889 and continuing through 1909.

As soon as the office undertook an annual inspection of the experiment stations its representatives, especially the director and assistant director, were brought into personal contact with trustees, presidents, and teachers in the colleges. Many opportunities were thus afforded to give and receive information regarding agricultural education. The college association began in 1894 through a special

committee to study entrance requirements and the general content of courses of instruction. And in 1895 the association appointed a standing committee on instruction in agriculture which has made reports annually since that time and which has had a broad influence on the organization and progress of agricultural education in this country. The director of the Office of Experiment Stations has been a member of this committee since its beginning and since 1902 has been its chairman. Having unusual facilities for the collection and dissemination of information on this subject, this office naturally became the headquarters of this committee, which thus was enabled to conduct its studies regularly and persistently. Gradually the office became a clearing house of information on agricultural education in this country and abroad. Annual reports on the progress of agricultural education were published for a number of years. The work went beyond collegiate instruction. Much active propaganda in favor of the introduction of agriculture and kindred subjects into secondary and elementary schools was carried on, definite propositions for courses of instruction in such schools were made, and in general there was much participation in the movement which has resulted in the teaching of agriculture in many secondary schools and in consolidated and some other elementary schools.

In the earlier years much attention was given to the encouragement of nature study and school gardening as introductory to more formal teaching of agriculture.

In 1902, on the suggestion of T. F. Hunt, dean of the College of Agriculture of Ohio State University, the first graduate school of agriculture in America was held at that university. The director of the Office of Experiment Stations was dean of that school. The faculty consisted of leading agricultural experts from the United States and other countries and the term of the school was the month of July. This school was so successful that a plan was worked out for other sessions under the auspices of the Association of Agricultural Colleges and the Department of Agriculture. Sessions were held with the same officer as dean at the agricultural colleges of Illinois in 1906, New York in 1908, Iowa in 1910, Michigan in 1912, Missouri in 1914, and Massachusetts in 1916.

By this time much graduate instruction leading to advanced degrees had developed in the agricultural colleges, and it was therefore unnecessary to continue this school, which had largely served its purpose as an encouragement to the establishment of regular graduate courses in these institutions.

In 1906 a section on agricultural instruction was organized in the Office of Experiment Stations and this was carried over into the States Relations Service. When the Federal Board for Vocational Education was established after the passage of the Smith-Hughes Act in 1917, the States Relations Service undertook to cooperate with that board in the preparation of subject-matter material for the use of teachers in the Smith-Hughes schools. This work is still continuing, and recently much attention has been given to formulating job analyses of various agricultural enterprises.

In the work relating to elementary instruction there has been cooperation with a number of State departments of education and agricultural colleges. In recent years, since the Bureau of Educa-

tion and the Federal Board for Vocational Education have been taking an active interest in the problems connected with the organization and administration of instruction in agriculture, the States Relations Service has confined its work to the preparation of subject matter in form for immediate use by teachers and to aiding teachers to obtain department publications, lantern slides, and other illustrative material.

### FARMERS' INSTITUTES.

Meetings of agricultural societies have been held in the United States since the closing years of the eighteenth century. In 1853, at a meeting of the Massachusetts Board of Agriculture, Doctor Hitchcock, of Amherst College, read a paper on "Farmers' institutes," which he suggested should be organized after the example of teachers' institutes. This name came into actual use for farmers' meetings in that State in 1870 and a little earlier in Kansas.

The agricultural colleges early took an active part in the institutes, though their administration was often committed to the State boards or departments of agriculture. By the time of the passage of the Hatch Act the institutes were recognized as important agencies for the dissemination of agricultural information and the Office of Experiment Stations took an interest in them from its beginning. Its work of aiding the institute officers and lecturers came to be of sufficient importance to justify a special appropriation for this purpose, which was first made by Congress in 1902, and in 1903 Prof. John Hamilton, who had been a teacher of agriculture in the Pennsylvania State College and secretary of agriculture in Pennsylvania, was appointed farmers' institute specialist. Annual reports on the progress of the institutes and of similar work in foreign countries have been published, the workers in the institutes have been furnished with publications, lantern slides, and other illustrative materials, and the interests of the institutes have been promoted in various other ways. The work of the institutes grew in extent and importance until in the years immediately preceding the passage of the Smith-Lever Extension Act over 7,000 of these meetings were annually held, over 1,000 lecturers were regularly employed, and the aggregate attendance rose to over 3,000,000 people.

Since the passage of the Smith-Lever Extension Act the institutes in most of the States have been made a part of the general system of extension work carried on by the agricultural colleges, and the department's work relating to the institutes is now conducted through the office of cooperative extension work.

### EXTENSION WORK.

From their beginning the agricultural colleges and the Department of Agriculture disseminated agricultural information among the farming people through correspondence, distribution of publications, and addresses at meetings by members of their staffs. This work was greatly increased through their connection with the farmers' institutes. The colleges gradually enlarged the scope of their extension work, particularly in the decade beginning about 1905, when distinct extension divisions were organized. Among the

activities added were reading and correspondence courses, extension schools, farmers' weeks, and other short courses at the college, exhibits at fairs, competitive judging of livestock and other products, and boys' and girls' clubs.

The spread of the cotton-boll weevil in Texas led the Department of Agriculture, through the Bureau of Plant Industry, to attempt not only to diminish the injury to the cotton crop by this insect but also to offset its attacks by improving the general practice of agriculture in the South. Through this movement there was developed, under the leadership of Dr. Seaman A. Knapp, beginning in 1903, the system of extension work through supervised demonstrations by farmers on their own farms, county agricultural and home demonstration agents, and boys' and girls' clubs. At first this work was independent on the colleges, but gradually they came into more or less definite cooperation with it. The States and counties in the South also made appropriations for its support. By 1914 more than 1,000 men and women agents were employed in 15 Southern States.

In 1909 the office of farm management of the Bureau of Plant Industry began farm-demonstration work in Ohio, and in 1911 the first county agent was appointed in New York. This work spread in the Northern and Western States in cooperation with the agricultural colleges, counties, and local organizations. In 1914 over 200 agents were employed in this work.

In 1905 a standing committee on extension work was appointed by the Association of American Agricultural Colleges and Experiment Stations. This committee reported in 1908 in favor of a Federal appropriation for extension work and in 1909 a similar recommendation by the committee was adopted by the association. As a result a bill for this purpose was introduced in the House of Representatives December 15, 1909, by Mr. McLaughlin, of Michigan. The same general proposition was embodied in other bills in both houses. The Department of Agriculture joined in this movement. After long and careful consideration Congress passed the Smith-Lever Extension Act, which was approved by President Wilson May 8, 1914.

This act was broadly drawn to make possible the establishment of a permanent nation-wide system of extension work in agriculture and home economics which would include both the demonstration and county agent system and the other useful features of extension work as developed by the agricultural colleges. It provided for definite cooperation between the colleges and the Department of Agriculture in the planning, administration, and conduct of the work. Soon after the passage of the act the department and the colleges generally entered into a formal agreement, through a "memorandum of understanding," regarding the organization of cooperative extension work and their respective relations thereto.

Pending authorization by Congress of a permanent organization in the department to carry on the business necessitated by this act, a committee consisting of the director of the Office of Experiment Stations and the chiefs of the two offices in the Bureau of Plant Industry which were conducting demonstration work was appointed by Secretary Houston.

On July 1, 1915, this business was taken over by the newly created States Relations Service. General supervision was committed to

the director of that service and the detailed work was intrusted to two offices of extension work transferred from the Bureau of Plant Industry. The office of extension work in the South was given charge of the work in 15 Southern States and the office of extension work in the North and West of the work in 33 Northern and Western States. In addition to work under the Smith-Lever Act, the States Relations Service has administered the direct department appropriations for farmers' cooperative demonstration work. These funds have been used mainly in the States, but also for the maintenance of the Washington extension offices.

Among the major problems which necessarily received much attention in the first years after the passage of the Smith-Lever Act were the interpretation of this act as related to the legality of expenditures under it; the establishment of a system for plans of work, budgets, accounting, and reporting; the uniting of the force employed by the department in the South with the college extension forces; the development on a larger scale of the county agent system in the North and West and the building up of home demonstration and boys' and girls' club work in that region; and the further development of organizations of farming people to support the extension work and participate in it.

The new plans and methods of work in the department and the States under the Smith-Lever Act and related Federal and State legislation were hardly well established when the entrance of the United States into the World War brought unusual difficulties and a very great expansion of effort. Most of the men engaged in extension work were of military age, many of them had special training which made them unusually useful to the Government in time of war, and their patriotism led them to offer themselves freely for such war service as the Government desired to have them undertake. At the same time the need of greatly increased agricultural production and the conservation of the food supply of the country called for the rapid expansion of the extension forces in order that the farming people might have as much help as possible from the colleges and the department in their efforts to meet these new demands on them at a time when the farm-labor supply was greatly depleted by the withdrawal into the Army and Navy of multitudes of the most vigorous men on the farms. Moreover, the Government needed agents in every county to explain to the people its aims in the conduct of the war and the extent of agricultural production and food conservation required by the war, and to keep itself informed regarding what was going on throughout the country and what measures should be taken to aid the people in their efforts to meet the unusual requirements brought about by the war.

Under the food production act the States Relations Service received $4,348,400 in 1917 and $6,100,000 in 1918. This money was used to supplement the regular Federal, State, and county extension funds in stimulating agricultural production and food conservation. Much of the work under the latter head was done in cooperation with the Food Administration. In other lines of war work there was also much cooperation with the Red Cross, Council of National Defense, War Department, Public Health Service, Fuel Administration, Treasury Department (in Liberty loan campaigns), and other agencies.

The organization of the counties for extension work was pushed forward very rapidly until over 2,400 counties had agricultural agents and about 1,700 counties and 200 cities had home demonstration agents. About 2,000,000 boys and girls were enrolled in clubs. The agents and clerks with headquarters at the colleges and the department were also greatly increased in number. At one time about 7,000 persons were carried on the rolls of the States Relations Service. The employment of so many people, many of whom were unfamiliar with the requirements and restrictions of Government service, made the duties of administrative officers very difficult and burdensome. However, the patriotic spirit and earnest purpose which pervaded the extension force throughout the country enabled it to do a great work in aiding the farmers to produce greater crops than ever before and our people generally to conserve their food supply.

To accomplish this task it was necessary to organize the farming people more thoroughly. The extension forces, therefore, were very active in promoting the older organizations and forming new ones. In the Northern and Western States farm bureaus were organized in a large number of counties. This had unexpected results after the war, when economic conditions aroused the farmers to the importance of cooperative marketing and of legislation pertaining to agricultural affairs. The county farm bureaus expanded their work beyond the educational field and formed State and National federations. This movement has spread into almost all the States and has resulted in one of the strongest and most influential of our farm organizations. It has made necessary a readjustment of the relations of the extension forces to the farm bureaus in order that the extension work may remain an educational enterprise.

In a broader way the period since the war has been a time of reorganization and readjustment of the extension work and forces to meet new conditions. When the war emergency funds were withdrawn the number of extension workers was materially decreased, while at the same time the expense of the work greatly increased and the economic status of the farming people became very difficult and depressing. In spite of these conditions the interest of the people in the extension work remained strong, and during the past year the number of county extension agents has begun to increase again.

The emphasis in the agricultural work shifted from production to economics, particularly cooperative marketing. Much has been accomplished in this direction and the extension forces have had a considerable share in bringing this about. It is now becoming clearer that successful and economic production is after all the farmer's greatest problem and the best foundation for successful cooperation in marketing. Undoubtedly greater relative importance will be attached to work on production in future extension enterprises.

The boys' and girls' club work, as a preparation for successful rural life and leadership in rural affairs, is attracting wider attention, and the number of young people enrolled in this work has materially increased during the past year.

The task of adjusting the extension work among the farm women to the conditions actually prevailing in the farm home and rural community has in many localities been quite difficult. While the extent and usefulness of that work is large in the aggregate, it has

not made much progress as regards the organization of new territory since the withdrawal of a large part of the home demonstration force immediately after the war.

An encouraging element in the present development of extension work, which it is believed will favorably affect the whole enterprise, is the increasing attention paid to community organization, involving larger and more intimate participation of both men and women in the planning and conduct of the local extension work.

With the nation-wide spread of the extension work and the approximate standardization of its purposes and methods it became apparent that it would be much better to have the Federal business connected with this work transacted through a single office in the States Relations Service. Therefore in 1920 the two offices were combined. Since that time much has been done toward adjusting the Washington office to new conditions in the department and the States. In order that the department as a whole might enter more fully into the extension work and the different bureaus might have more definite relations to the extension office and the State and county cooperative workers, general supervision of the extension work of the department has been temporarily given to the Assistant Secretary of Agriculture and the way prepared for such supervision by a permanent director of extension work, provided for in the appropriation act for the next fiscal year. Extension representatives of different bureaus have been put under the direction of the office of cooperative extension work as regards their plans of work and contacts with the field, while they office in the bureaus which are held responsible for the subject matter of their extension teaching.

The Washington extension office has been reorganized into three divisions: (1) Office administration, (2) programs, and (3) methods of extension organization and teaching. The division of programs carries on the work relating to the administration of the Smith-Lever Act and related Federal legislation, including plans of work, budgets, inspection of work and expenditures, and consultations with State extension officers regarding the administration of their work. The division of methods collects and disseminates information regarding methods of organization of different lines of extension work and methods of extension teaching of different subjects. Contacts with the extension forces in the field are made through the extension directors. A distinct effort has been made to consider the extension work as one unified enterprise for the benefit of the men, women, and children on American farms and to interest all extension agents in the promotion of the enterprise as a whole, rather than simply the particular line of work in which they individually are engaged.

During the nine years since the passage of the Smith-Lever Extension Act a broad system of practical instruction for the men, women, and children on American farms, outside the schools, has been developed on a permanent basis by the cooperative efforts of the department and the State agricultural colleges, aided by the counties, farm organizations, and numerous individuals. This extension system is now organized to a greater or less extent in over 2,100 agricultural counties and annually reaches directly several millions of our farming people. More and more it has formed a broad basis of popular support of research and education in agriculture and

home economics through Federal, State, and local institutions, and undoubtedly the influence of the extension work will be increasingly felt in the development of these institutions.

### EXHIBITS AT EXPOSITIONS.

The Office of Experiment Stations did a large amount of work in cooperation with the agricultural colleges and experiment stations in the preparation and management of collective exhibits of its own work and that of the cooperating institutions at the expositions at Paris in 1889 and 1900, Chicago in 1893, Atlanta in 1895, Omaha in 1898, Buffalo in 1901, Charleston in 1901–2, St. Louis in 1904, Portland in 1905, Jamestown in 1907, and Seattle in 1909.

## THE CHANGE IN DEPARTMENT ORGANIZATION AFFECTING THE STATES RELATIONS SERVICE.

The Office of Experiment Stations and its successor, the States Relations Service, have necessarily dealt so broadly with matters relating to agricultural research and education that they have constantly operated in fields of subject matter covered also in the work of the department bureaus. The relations of the bureaus with the agricultural colleges and experiment stations have also become increasingly intimate and cooperative. There have therefore developed good reasons for such a reorganization of the department's agencies dealing with the colleges and stations as would bring them within the office of the Secretary and put them in charge of officers representing the department as a whole. This has been provided for in the creation of the offices of director of scientific work and director of extension work and by authority from Congress to abolish the States Relations Service on June 30, 1923, the Office of Experiment Stations to be put in charge of the director of scientific work and the office of cooperative extension work in charge of the director of extension work.

The office of home economics will be transformed into the Bureau of Home Economics and thus will have the same status as the other bureaus of the department.

Through these changes a more logical arrangement for the transaction of the department's business hitherto conducted by the States Relations Service will be made, which it is hoped will have very satisfactory results and strengthen the cooperative relations of the department with the State institutions for agricultural research and education.

The Office of Experiment Stations and the States Relations Service have been operated under practically the same general policies for 35 years and to an unusual extent for many years in the more important positions by the same personnel. During their existence these agencies have been closely identified with the general movement for agricultural research and education and have done much toward the development of this movement in a broad way and on a permanent basis, with results which already have brought about many improvements in agricultural practice and in the home and community life of our rural people, as well as contributing in large measure to the general welfare and prosperity of our urban people.

These Federal agencies have in a large way demonstrated what can be done through broad advisory and cooperative relations with State and local institutions and organizations when a fairly consistent policy is pursued during a considerable number of years and loyalty to successive administrations representing different parties is combined with freedom from the objectionable features of political control.

It has been the aim of these agencies to establish standards for the organization and conduct of our institutions for research, teaching, and extension work in agriculture and home economics; to emphasize the great importance of fundamental and continued research in these fields; to aid in putting the teaching of agriculture and home economics in colleges and schools on an equal footing with other subjects taught in such institutions; and to help in developing a broad system of practical instruction for the men, women, and children on our farms which would include matters relating to agricultural production and economics, and to the material and social interests of the farm home and the rural community. Whatever has been accomplished in these directions has been brought about through the active and cordial interest and cooperation of many institutions and individuals in all the States and Territories.

A most encouraging feature in the development of the American system of agricultural research and education has been the growth of the cooperative spirit in the institutions and organizations devoted to this work. This has manifested itself in greater measure and in a larger number of worth-while enterprises with the progress of the years, and the outlook for the future is very promising.

## A REVIEW OF THE WORK OF THE PAST YEAR.

The more important features of the work of the different divisions of the service during the past year are briefly reviewed in the following pages.

### OFFICE OF THE DIRECTOR.

The general administrative business of the State Relations Service connected with appointments, accounts, supplies, and the preparation and dissemination of publications and illustrative material was large in amount and covered a great variety of subjects involved in the work of the agricultural experiment stations and extension divisions of the agricultural colleges.

After the establishment by Executive order of the Federal Council of Citizenship Training, the director of the service was designated by the Secretary of Agriculture as the representative of this department on that council and has since participated in its work.

### EDITORIAL DIVISION.

W. H. Beal, *Chief.*

The editorial division handled, as heretofore, the business of the service relating to publications, job printing, publicity, duplicating, and illustrative material.

Publications.—There were printed for the service during the fiscal year ended June 30, 1923, 52 technical and popular documents,

aggregating 3,480 pages, as follows: 21 numbers of Experiment Station Record, including 3 index numbers; 3 administrative reports, including the report of the Director of the States Relations Service, 1922, work and expenditures of the agricultural experiment stations, 1920, and cooperative extension work in agriculture and home economics, 1921; 14 publications of the experiment stations in Alaska and the insular possessions, including reports of the Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands experiment stations for 1921, 2 bulletins of the Hawaii station, 2 bulletins of the Porto Rico station, 3 bulletins and 1 circular of the Guam station, and 1 bulletin of the Virgin Islands station; 1 department bulletin dealing with the digestibility of various oils and blended hydrogenated fats; 6 department circulars dealing respectively with county-agent, home-demonstration, and boys' and girls' club work, extension work in the Southern States, homemade apple and citrus pectin extracts, Federal legislation, regulations, and rulings affecting land-grant colleges and experiment stations, and statistics of cooperative extension work; 2 farmers' bulletins dealing respectively with corn and its uses as food and good proportions in the diet; and 3 miscellaneous documents giving lists of workers in subjects pertaining to agriculture, and dealing with education and research in agriculture and home economics in the United States, the latter prepared for distribution at the Brazil Centennial Exposition.

About 40 orders for job printing and binding were handled during the year.

The division cooperated with the press service of the department in assembling and preparing about 500 articles relating to the work of the service for press release and for the Official Record.

Approximately 265 pieces of duplicating were done for the service during the year by the Division of Publications, and 465 pieces by the small duplicating unit operated under the direction of the editorial division.

Illustrations Section.—This section cooperated with other offices of the service in securing several carefully planned series of photographs illustrating the work of the service for use in publications, publicity, and exhibits, and for distribution in lantern-slide form. Eight States (Maryland, Virginia, West Virginia, Ohio, Iowa, Minnesota, South Dakota, Michigan, Pennsylvania) and points in the District of Columbia were visited for this purpose during the year.

About 2,200 photographs were added to the collection, making the total number now in the collection 18,608, of which 16,166 are mounted, classified, and catalogued for ready use.

In cooperation with other offices of the service and other bureaus of the department, 16 series of lantern slides were prepared for the use of extension workers and agricultural teachers on the following subjects: Farm drainage in the humid section, child feeding, growing annual flowering plants, farm dairy houses, sheep judging and breeds of sheep, foot-and-mouth disease, judging breeding cattle, preparing beef cattle for show or sale, control and reclamation of gullies, educational milk-for-health campaigns, important cultivated grasses, how to get rid of rats, the anatomy of the honeybee, exhibit shown at the International Live Stock Exposition, exhibit at the National Dairy Exposition, and the United States Department of Agriculture.

The preparation of 23 other series and revisions of outlines of two series previously issued were undertaken. A total of 858 sets of slides were distributed for the various offices of the service.

Over 6,600 lantern slides, 277 bromide enlargements, and 68 posters were colored, and 327 charts, drawings, and designs were made in the section. In addition the photographic laboratory of the Division of Publications prepared for the use of the service 3,124 negatives, 14,048 prints, 6,622 slides, and 1,207 miscellaneous items, inclusive of blue prints.

In cooperation with the office of extension work outlines for four motion pictures were prepared and submitted to the office of motion pictures as follows: (1) Birds of a feather, (2) A letter to dad, (3) Bill Jones—champion, and (4) Seeing Washington; and a program for producing motion pictures especially adapted to extension use was developed, including 39 subjects, 11 of which, now in various stages of production, are as follows: (1) Improved potato production through seed selection and certification; (2) Efficient farm home management, including budgeting of funds and the selection of food, clothing, and equipment; (3) The farm garden as a source of a better diet for the farm family; (4) Cooperative marketing of livestock (beef cattle and hogs); (5) Production and distribution of improved cereal seeds; (6) Liming soils with special reference to the use of ground limestone; (7) Tobacco marketing; (8) Community cotton standardization; (9) Cooperative cotton marketing associations; (10) Improved management of range sheep; and (11) Improvement of conditions in farm homes through installation of conveniences and improvement of surroundings.

In addition to giving field employees of the service information and assistance in the preparation of exhibit material, the section is cooperating with the office of exhibits in the preparation of material for two interstate boys' and girls' club work exhibits (Springfield, Mass., and Sioux City, Iowa) under the supervision of the office of extension work, similar to those held last year. It also cooperated in the preparation of exhibits for the National Dairy Show and for the International Livestock Show. With the cooperation of the office of extension work and the office of exhibits, a program for the preparation of exhibits supplementing the cooperative extension program and bringing extension workers in the Washington office in closer contact with exhibit activities was developed.

At the request of State extension services and State departments of education, short talks and demonstrations were given in methods of extension photography and the preparation and use of illustrative material by a representative of the section at conferences in eight States (North Carolina, Virginia, South Dakota, Iowa, Minnesota, Indiana, West Virginia, and New Jersey).

### INVESTIGATIONS ON AGRICULTURAL INSTRUCTION IN SCHOOLS.

E. H. Shinn, *Chief Specialist in Agricultural Education.*

The work of the service relating to agricultural instruction in schools continued during the year along practically the same lines as heretofore. There are distinct evidences of progress in the development of vocational agricultural education. New schools have been

established as a result of an increase in appropriations from both State and Federal sources, and the increase in the number of schools has created a demand for more teachers of agriculture. The agricultural colleges and a few of the State normal schools, designated as agencies to train teachers for the vocational schools, have succeeded in most cases in graduating a sufficient number of teachers each year to meet the increased demand. Since the passage of the vocational education act in 1917 there has been rapid development and improvement in the teaching of agriculture in secondary schools. The supervised practice work on the students' farms is functioning better in the community and is stimulating greater public interest in the study of agriculture in the schools.

There has also been increased interest in the teaching of agriculture in the elementary rural schools, and officials in charge of vocational agricultural education in the high schools are in many instances actively assisting in developing programs for teaching agriculture in the upper grades of the elementary schools. The agricultural courses offered in the rural schools have been strong influences in certain localities in stimulating students to enter the agricultural classes in the high schools, commonly known as Smith-Hughes schools.

More than half of the States either require or encourage the teaching of agriculture in rural schools. Many teachers in these schools are therefore anxious to secure material that will be helpful in teaching agriculture. The division of agricultural instruction endeavors to make available to both teacher and students of agriculture useful material derived from the large amount of agricultural information which has been accumulated by the department and the State agricultural colleges and experiment stations. Since better facilities are now offered in the agricultural colleges, the State normal schools, and the secondary agricultural schools for training agricultural teachers these institutions desire to obtain the latest developments in methods of instruction and other information which can be used by them to good advantage. To meet this demand the division cooperates with the subject-matter specialists of the different bureaus of the department in the preparation of outlines and in making available to agricultural teachers other helpful information.

Cooperation was continued during the year as heretofore with the following agencies outside the Department of Agriculture: (1) The Federal Board for Vocational Education, (2) States which desire to have prepared special outlined courses of study in agriculture for rural schools, (3) teacher-training divisions in the States, and (4) teachers in service.

The division continued to cooperate with the Federal Board for Vocational Education in analyses of certain farm enterprises. A publication entitled "Suggestive Job Lesson Units on Some Truck and Fruit Crops Adapted to Southern Conditions" has recently been completed, and a job analysis of the management of a farm business is being prepared. Analyses of farm enterprises on corn, cotton, and dairying are being planned. Such analyses are now much in favor as a basis for vocational instruction in agriculture in the schools receiving the benefits of the vocational education act.

Cooperating with State departments of education and State agricultural colleges in the preparation and use of courses of study in

elementary agriculture for rural schools, the summer schools in North Carolina were visited and suggestions were made as to the best use of the course of study in elementary agriculture prepared for that State. Conferences were also held with the State superintendent of education and other officials in Arkansas in regard to the use of the course of study in agriculture prepared recently for that State. The departments of education of these two States report that these courses are being used extensively by the rural teachers. Courses of study in elementary agriculture for rural schools in Oklahoma and Utah are now in the process of preparation.

The division has cooperated closely with the teacher-training divisions of the land-grant colleges through conferences and correspondence. They have also been supplied with publications, lantern slides, motion-picture films, and sources of information regarding other helpful material.

There has been an increasing demand from teachers of agriculture in service for publications of the department and for information regarding the sources of other materials needed in their work. Large numbers of teachers have been furnished lists of publications of the department best adapted to their needs. Teachers are realizing more and more the value of the Farmers' Bulletins of the department, not only for their own use, but for students as supplementary reading in connection with their regular textbooks. These teachers have also been supplied with large numbers of sets of lantern slides during the year. Plans are being made to revise many of the sets of lantern slides now in use and to prepare additional sets.

The division keeps in close contact with new developments in agricultural education by attending and participating in annual conferences of State and National workers in this field. One member of the staff attended the annual meeting of the National Society for Vocational Education and conferred with teachers regarding progress in the development of teacher-training programs and secured suggestions relative to the practical value of certain publications prepared by the division. Another member of the staff attended the National Education Association and discussed the topic, "What school credit should be given for school garden work in elementary schools?"

A representative of the division attended and took part in the conference called by the United States Commissioner of Education in cooperation with the Federal Board for Vocational Education, which met at Tuskegee, Ala., January 15 and 16, 1923. This was one of a series of annual conferences which have been called during the past three years, looking to a better standardization of the curricula of the negro land-grant colleges. Much interest has been manifested in these conferences by leading white and colored educators of the Southern States. Reports were made on standards of equipment, qualifications of teachers, actual funds available, and types of curricula. It is evident that these conferences are having a stimulating effect on the negro colleges. White and negro educators of the South are realizing the need of raising the standards and of increasing the efficiency of the negro land-grant colleges. The director of the service addressed the conference on "The importance of vocational education under modern industrial conditions and the growing demand for trained workers in agriculture and other vocations." He

urged the presidents of the negro land-grant colleges to develop strong vocational courses rather than to put too much emphasis on the academic subjects.

Cooperation with the Association of Land-Grant Colleges was continued through its committee on instruction in agriculture, home economics, and mechanic arts, of which the director of the service is chairman. The committee made a report on "Methods for the professional improvement while in service of college teachers of technical subjects," with special reference to (1) the means employed to encourage the professional improvement of teachers of agriculture, home economics, and engineering subjects while actively engaged, and (2) the practices with reference to assigning work to young teachers as between subjects narrowly specialized and those of a more general character. In preparation for the next report of the committee members of the staff visited the agricultural colleges in a number of the States to confer with presidents and deans in regard to efforts that are being made by the land-grant colleges to adapt the methods of instruction to students of varying capacities.

The division continues to review and abstract the literature on agricultural education for Experiment Station Record.

## OFFICE OF EXPERIMENT STATIONS.

E. W. Allen, *Chief.*

The past year completed 35 years of operation of experiment stations in the States under the Hatch Act. The maintenance of these State stations has been a great cooperative undertaking, the most notable example of joint effort in the support of research to be found in any country or any field of science. That it has been successful is attested by the position these institutions have attained and by the fact that no previous period has marked such notable advancement in knowledge of matters relating to the principles and practice of agriculture. In no other time have such extensive and far-reaching additions been made to the fund of facts, scientific reason, and understanding as in the third of a century involved.

The cooperation on the part of the Federal Government in this vast enterprise has not been confined to the donation of funds and their technical audit. It has been in the nature of participation—not in the actual conduct of investigation, but in the provision and stabilizing of conditions essential to productive research. Few parallels are to be found in the administration of funds for scientific research. Through the Office of Experiment Stations the Federal Government has followed its funds into the States, and has seen to it that they were devoted to the purposes originally intended. This has inevitably meant, not alone the interpretation of the Federal acts, but the defining of research efforts, the setting up and development of ideals, and the outlining of the essentials fundamental to the proper employment of these resources. This interpretation of implied requirements has been progressive, taking account of the general status of the stations in the States and the character of aid most needed from them. Naturally it has advanced with the changing conditions surrounding these stations, the increase in the channels for the diffusion of agricultural information, and the demand for more intensive study of certain types of problems.

Throughout the course of this administrative control the effort has been to lead through the force of influence rather than to require by administrative action. Occasionally the veto power has been necessary, but for the most part the largest measure of local initiative and judgment has been encouraged. The advantage of this course has been steadily demonstrated with advancing years. The cordial and sympathetic relations which have prevailed with the stations have made suggestions welcome and have made it possible to bring about changes where desirable without reference to the authority provided by law. Occasionally, however, progress has seemed so lacking and public sentiment so inadequate of expression as to necessitate more affirmative action.

A case in point, which illustrates anew the disregard of the essentials to productive research, occurred the past spring in Oklahoma. The overthrow of the president of the college after only a two-year period of service has been accompanied by the practical disruption of the station forces and the jeopardizing of its investigations. The requirements of a successful and efficient station have not yet been realized, and hence after all these years it is not immune to danger from such instability. Research is from its nature the first branch to be seriously affected by change and uncertainty, and the effects are more far-reaching than in any other branch of the college. Since 1900 there have been 10 changes in directorship at that station, which in itself illustrates the impossibility of any fixed continuous policy. These and the many changes in staff have resulted in projects becoming well-nigh sterile, with little real progress from one period to another and a frequent losing sight of the original objective.

Fortunately, these conditions are very exceptional. For the most part the stations have made steady advancement in the past few years in strengthening their forces and their work and raising their investigation to a higher level. Although few of them have received material increase in State appropriations since the close of the war, they have, by the reorganization of their work and a reduction in the number of leading projects, placed themselves in a stronger position for advanced inquiry. Their means are in many cases quite inadequate to the needs, but to meet the situation this office has urged a revision of the programs of work, careful study of the field to determine the more important lines of operation, and a scrutiny of long-time projects to determine their exact status and the further steps warranted.

The publication from year to year of the program of work of the experiment stations, consisting of a classified list of the projects of all the stations, has had the effect of calling this matter forcefully to mind. The request for the list of active projects, sent out in connection with the annual revision of this program, and the correspondence following it have led to modifications of title, frequently a narrowing of scope, and the giving of more definite direction to projects which had become largely routine.

During the year a revision of the list of projects has been nearly completed, which when issued will constitute the fourth of the series. There has been increasing call for this document as it has come to the attention of workers. This call is not confined to investigators in the experiment stations or, indeed, to this country, but the list has seemed

to be a matter of widening interest. It is supplying the basis for a larger measure of cooperative effort and is obviating duplication in cases where it is not justified. This list is issued in mimeographed form in an edition of only a few hundred copies.

### RELATIONS WITH THE STATIONS.

During the year all the experiment stations in the States receiving Federal funds were visited by a representative of this office. On these visitations the accounts on the Federal funds were examined in detail, and the exact use made of these funds, in administration and in the carrying out of specific projects, was determined. In this connection the principal attention is given to conferences with the director on matters relating to the work and administration of the station and discussions with individual members of the staff regarding the progress of their projects. While in the latter special consideration is aimed at those projects supported partly or wholly from Federal funds, the work of the station as a whole largely comes into consideration. The attempt is made to secure a comprehensive view of the investigation carried on by each station with all its funds and the general situation surrounding it.

There is a very general desire on the part of directors that no man's work shall be overlooked, but that the office representative shall take the time to go over the projects of each individual and supply suggestions and criticisms freely. Indeed, constructive criticism is welcomed by the station authorities and suggestions are invariably invited for the strengthening of the activities in various lines or the promotion of the general welfare of research. This annual visitation, with its personal contact with the station officers and workers, continues to be an important factor in the exercise of helpful relations with the experiment stations.

To meet the requirements of the new classification of accounts, devised by the office of the Comptroller General and applying to all funds required to be reported to Congress, a revised system of classification of experiment-station accounts has been prepared. This is an adaptation to the essentials of the new Government system, retaining such former headings as feasible, in order to make the reports for the future more nearly comparable with those in the past. To assist in the introduction of this new system in the station accounting offices an analytical key or glossary has been prepared of quite comprehensive character to replace the one formerly in use.

A difficulty which is sometimes met with in the administration of the Federal funds grows out of an increasing disposition to impose local regulations of the funds of the colleges, both State and Federal, and to prescribe procedure which restricts the free use of these funds. In some cases the regulation of expenditures is becoming quite drastic and threatens to interfere with the application of the Federal funds or hamper their use. This matter is being inquired into quite closely and the effects determined. The Federal funds for the stations are paid in advance, in order that the latter may be able to meet promptly the requirements of their investigations, and it is maintained that no procedure should be set up which will interfere with this or place the station at a disadvantage in the use of these funds after plans have been approved by the local authorities.

Correspondence with the stations continued to be heavy throughout the year. It related to matters of administration and policy as well as to projects and accounts. A considerable number of new projects have been submitted for review and approval, while in other cases the office has requested the revision of existing projects to make them more effective, and in still other cases has advised that steps be taken toward their completion and termination. Greater attention to the making of a general plan of operations to cover a period of several years has been advocated, and steps in that direction are being more generally taken. The more definite planning of specific projects is also being emphasized, with full reference to the present status of information and a clear setting forth of the problem in restricted form, an indication of the point of attack, and the general method of procedure. From an administrative standpoint this is found by directors to be increasingly important, serving to maintain latitude and direction without unnecessary restriction.

The office has compiled a list of the station bulletins from their beginning, at the suggestion of the director of scientific work. This makes a voluminous document, but should be helpful as a check list and as a means of determining when and where specific investigations were carried on and published.

The chief of the office has continued to cooperate with the standing committee of the Association of Land-Grant Colleges on experiment station organization and policy, and with that on projects and correlation of research.

### PROBLEMS OF ADMINISTRATION.

Many administrative problems continue to surround the stations, and these have been the object of considerable attention. Emphasis has continued to be laid on the distinctive place of the experiment station in the scheme of the agricultural college. This calls for an organization and administration to deal with its work and the general promotion of its welfare. There is still opportunity in some cases for the perfection of the station organization, the recognition of its distinct field, and the direction of its energies in the most profitable channels. Not only the conservation of its resources, both technical and financial, but the development of an esprit de corps and of a consciousness of membership in an organized branch of effort, are implied in the type of organization advocated. In some cases there has been little progress in the direction of closer unity of purpose and responsibility to the station and its constituents as a whole, while the division of former departments and the multiplication of units has sometimes tended to diffuse and segregate interest. It has led also to a less distinct recognition of the special field and function of the station as an agency primarily for research.

The combination of the office of dean and director has not always worked advantageously to the station, and has been the subject of no little comment on the part of the office. Frequently it is not adequate to the needs of the station for administrative attention, and it does not necessarily result in the selection of a person especially competent by training and experience to exercise leadership in research. Such a form of organization may affect the office in its relations with the stations connected with large colleges. Unless an associate is

provided to follow the affairs of the station, there is scant time for adequate consideration of matters which are fundamental to a studied program of operation and the highest effectiveness of the station. Without provision for adequate study and attention to station affairs, the conditions for growth are not favorable and increased funds will not necessarily mean larger effectiveness.

In its dealings with the stations, the development of local leadership has been urged by the office as one of the fundamental requirements. This relates not only to lines of work and the organization of projects around problems too complex for a single division, but to the work of the station as a unit. It is contended that administration has its function in research as in every other organized effort, and this implies more than the routine of correspondence, reports, allotment of funds and approval of vouchers. Training and insight which enable critical judgment, the exercise of a sympathetic and appreciative attitude, and vision of possibilities and means of accomplishment, are important assets in the administration of a research institution.

These things are of vital importance, as is evident when a national view of the situation is taken; and this has led to the pointing out of weaknesses and the urging of a stronger organization. In a number of cases the station organization has become quite loose and is little more than a nominal one. In such cases the station has little cohesion or existence as a definite institution or department, but stands as an aggregation of separate divisions having little interest in common. To an extent this may result in the obliteration of boundaries or distinctions between the station functions and those of other branches of the institution.

Some tendency in the latter direction is developing in relation to the graduate school, to which attention has been directed by the office. The employment by the station of students engaged in graduate work in the college has grown from small proportions to a quite widely recognized practice. Statistics collected show that at least half the stations are now making use of graduate students in their work, the number being as high as 15 in some stations. Commonly such graduate students receive pay for their labors, and they are often given the rank of research assistant in the station staff. Many stations use for these scholarships funds assigned to the station for research, the amount ranging in individual cases from a few hundred dollars up to as much as $15,000 a year. Wherever the Federal funds have been so used, special attention has been given to the nature and amount of the services rendered, and in some individual cases objection has been made to the practice.

The experiment station laboratories and problems may on occasion offer special opportunity for the graduate student, the station may be able to utilize such services to its advantage in prosecuting its problems, and in general it is to the interest of the stations to encourage graduate study along agricultural lines as a means of increasing the supply of trained investigators. But this, it is contended, ought not to result in any confusion of function, or to be done at any sacrifice of the station's funds or the provision of a competent staff of workers. Reliance upon such help in place of trained assistants and more continuous service is advised against.

and is not in accord with the expectations in maintaining an experiment station as a competent going institution.

Another matter to which effort has been directed is the securing of a more definite and exact exposition of the financial resources of the stations for research. Conditions have left considerable to be desired in this respect. This is especially the case with certain stations where there are difficulties in drawing the lines between the research activity and other activities of the college, or where there have been turned over to the station large regulatory, commercial, and other enterprises. A clearer determination of the funds actually available and employed for constructive inquiry will enable more critical examination of their use and develop more definitely the actual need for added support. It will furthermore avoid error in the public mind as to the support already accorded. It is planned to inaugurate a classification of returns in connection with the annual financial report which will make possible a more reliable interpretation of the amount and use of non-Federal funds.

### EXPERIMENT STATION RECORD.

During the year volumes 47 and 48 of the Record were completed, each consisting of the usual nine numbers and an index number. No large deviation was made from the prevailing policies relative to the periodical, about 92 per cent of the space available being utilized for the presentation of technical abstracts of the current scientific literature pertaining to agriculture, and the remainder to monthly editorials discussing problems relating to the promotion of agricultural education and research and brief notes on the progress in these subjects at home and abroad.

The primary function of an abstract journal such as the Record is, of course, to conserve the time of investigators, teachers, and other workers interested in the current and previous literature in their respective fields. The magnitude of this task for the individual under present-day conditions may perhaps be better appreciated when it is stated that in the case of the Record an average of about 200 periodicals are examined daily, together with fully 9,000 books, pamphlets, and similar publications each year. From this great bulk of material a total of 6,644 articles, aggregating nearly 300,000 printed pages, were selected for abstracting, reduced during the process to about 13 lines per abstract, and assembled in classified form to make a total for the two volumes of only 1,653 pages. When it is recalled that these publications originate all over the world and appear in more than a dozen foreign languages, the need for a service of this sort from a centralized agency becomes apparent. In the case of the Record the mere assembling of the raw materials is in itself a large undertaking and one which would hardly be feasible but for the resources and facilities of the department library and the active cooperation of its staff.

With the beginning of volume 47 the listing in Experiment Station Record of the various scientific contributions of members of the department to outside publications was discontinued. A similar list is compiled by the staff of the Official Record, and as this periodical appears weekly more prompt dissemination of the information is secured through this channel.

Preparation was resumed of the revised list of abbreviated titles of periodicals used in the Record, for which many requests have been received. The revision was nearing completion at the end of the year, and its early distribution was anticipated.

Following the issuing of more rigid restrictions as to the free distribution of the department's periodicals a revision of the Record mailing list was completed. Requests for both current and back numbers of the publication have been unusually numerous, especially within recent months, indicating that it is continuing to render a service which is being much appreciated.

### DIVISION OF INSULAR STATIONS.

WALTER H. EVANS, *Chief.*

The agricultural experiment stations maintained by the Department of Agriculture in Alaska, Hawaii, Porto Rico, Guam, and the Virgin Islands of the United States are administered by the Division of Insular Stations of the Office of Experiment Stations.

The policy laid out for these stations when they were established was the development and diversification of agriculture of their respective territories. At that time Alaska had no agriculture; that of Hawaii, Porto Rico, and the Virgin Islands centered on sugar production; and that of Guam was in a very primitive condition, with many of the ranches abandoned and food production at a low state. By consistently following the original policy the stations have accomplished a great deal, and new agricultural industries have been established, some of which are in a flourishing condition.

During the past year all the projects of the stations were reviewed and a number were suspended or terminated. An effort is being made to concentrate on fewer projects and to bring some of them to a conclusion, so that other pressing problems can be given attention.

Practically every station is in need of a larger income, so that the work may be properly developed. The incomes of the several stations for the fiscal year 1923 were: Alaska, $75,000; Hawaii, $50,000; Porto Rico, $50,000; Virgin Islands, $20,000; and Guam, $15,000. These sums have not been changed since 1920, except that the appropriation for Guam was reduced $10,000. During the war period miscellaneous expenses were kept as low as possible, and many desired buildings and repairs were deferred to a more propitious time. Following this policy, during the fiscal years 1918 to 1922, the stations returned to the United States Treasury $11,618.54 and there was deposited in the Treasury as miscellaneous receipts derived from the sale of products $32,709.67. The officers in charge of the stations report very urgently needed improvements. At the Fairbanks station the log buildings erected in 1907 are deteriorating rapidly, and there is need of more cleared land at the Fairbanks and Matanuska stations to supply pasturage and feed for the rapidly increasing herds and flocks. The Guam station is in need of additional buildings, and the animal husbandman in charge of the station reports that the damage done by the typhoon of March 26 probably would not have been so great had it been possible to keep the buildings and fences in good condition. The Virgin Islands station is sorely in need of adequate water storage to carry it over periods of light

rainfall such as have prevailed here for the past three years. The Hawaii station needs funds for sanitary sewers to connect with those of the city of Honolulu, which has grown up to and is surrounding it on two sides.

A few changes in personnel took place during the year. The vacancies reported last year have not been filled through a lack of funds to pay adequate salaries. Not one of the stations is fully manned at this time.

### ALASKA STATIONS.

The climatic conditions in the interior of Alaska during the summer of 1922 were very unfavorable for crop production. An unprecedented rainfall of 5.37 inches at Fairbanks in July, accompanied by an unusual number of cloudy days, retarded normal development of all crops, and frosts during the last week of August destroyed all grain crops in the fields. About 200 acres had been seeded to grain in the Tanana Valley, and after the frost the crops were cut and made excellent hay. At the Fairbanks station some of the grains seeded in small plats matured a portion of their seed. This enabled the station to maintain seed of some of the valuable hybrids with which it was experimenting. Through the Farmers' Cooperative Association about 50 tons of seed grain was secured from the Dakotas for seeding in 1923. Conditions were as unfavorable for grain at the Rampart station as at Fairbanks.

In the Matanuska Valley conditions were similar to those in the Tanana Valley, but being considerably farther south the frost damage was not so severe and some crops matured in the fields at the station and elsewhere. In the plat trials at the station, sufficient grain matured to insure the continuation of most of the hybrids that were under trial.

Root crops did better than grains, though the potato crop was lowered in quantity and quality by the unfavorable season at the interior stations.

Hardy alfalfas and grasses, especially *Bromus inermis*, were favored by the heavy rainfall and produced excellent crops, though they matured less seed than usual. Several strains of alfalfa survived the winter at the Matanuska station. Canada field peas made vigorous growth in the Matanuska Valley, but did not mature and were cut for hay.

The work at the Sitka station was continued along horticultural lines, the climate of southeastern Alaska not being suited to grain farming. Experiments in producing hardy varieties of strawberries by crossing commercial varieties with the hardy native species have progressed to a stage where some of the hybrids are being given wide trial, and although they were produced in the coast region several have proved winter hardy at the stations in the interior of the Territory and elsewhere. Considerable attention is given to the production of new varieties of potatoes through the growing of seedlings. Out of about 200 seedlings some very promising forms have been secured that will be given a wide trial to determine their adaptability to Alaskan conditions.

The livestock work at Kodiak has been reduced, as the income of the station would not permit its continuance on the previous scale.

The number of purebred Galloways has been reduced by sales, and the station now is maintaining only enough to continue its experiment in the production of a hardy milk cow by crossing the Galloway and Holstein breeds. Although this experiment has been in progress since 1916, developments have been very slow, owing to the limited number of animals available and the fact that about 75 per cent of all calves have been males. There are now three crossbred heifers in milk, and their milk production appears to be about midway between the records of the purebred herds. All the crossbred animals have the rangy bodies of the Holstein breed and the black coats and polled characters of the Galloways. As a result of the reduction in the station herd the stock is now quartered at Kodiak and the Kalsin Bay station has been closed, temporarily at least. The present purebred herd at Kodiak consists of 7 cows, 2 bulls, and 4 calves of the Galloway breed and 4 cows and 2 bulls of the Holstein breed. Of the crossbred animals there are 5 heifers and 2 bull calves. The best of the sheep in the Kodiak flock were sent to Matanuska, where they are doing exceedingly well, an increase of 100 per cent being reported in 1923. The Milking Shorthorn cattle are proving well adapted to the regions of Fairbanks and Matanuska. With the increase in the herds at Matanuska and Fairbanks there is an immediate need of more cleared land for pastures and for the production of hay. At Kodiak additional land was added to the station in 1922. Fencing and clearing was begun, and it will soon be possible to produce all the pasturage and silage needed without having to cut grass in widely scattered areas and bring it in by boat.

The work at the Rampart station has been temporarily reduced to growing in small quantities the hybrid grains and the forage crops that have been under test at that place. This station seems especially adapted to work of this character. Pending the resumption of plant breeding the station is in charge of a caretaker.

Beginning in May, 1923, the stations have taken up cooperative and demonstration work with farmers in the more developed valleys of the Territory. M. D. Snodgrass, who was for seven years in charge of the Fairbanks station and previously in charge of the Kodiak station, was appointed to have immediate charge of this work, and he will visit the different localities, so far as possible, and advise the farmers and homesteaders concerning their problems. It is expected that he will establish cooperative tests of grains and vegetables in many places and thus gain information regarding their adaptability much more rapidly than formerly. Supplies of seed were furnished him and the work was begun very auspiciously. It is believed that this new enterprise will prove popular and of great advantage to the farmer settler.

### HAWAII STATION.

The station is continuing its efforts to develop agricultural industries that will supplement the growing of sugar cane and pineapples and make the islands less dependent upon the mainland for their necessities. It is well recognized that dependence could not long be placed on sugar and pineapples to maintain the people in case of isolation, and consequently the station is trying to solve some of the principles underlying the production of minor crops in the

hope that under normal conditions the surplus could be exported and under stress they would serve to feed the population. When the station was established pineapple production was in its infancy. One of the earliest investigations undertaken was that of the disease known as pineapple yellows. It was found that the trouble was due to an excess of manganese in the soil, and that spraying the affected plants with a solution of iron sulphate would control it. This can be done at small expense and has made possible the replanting of more than 10,000 acres on which pineapple growing had been abandoned. The growth of the pineapple industry is shown by the fact that exports in 1903 were valued at $7,500 and in 1921 at $29,841,000.

The horticulturist continued his investigations on tropical fruits and especially of their propagation. During the year a modified tongue graft was found adapted to the propagation of the mango, 96 per cent of the grafts proving successful as compared with 50 per cent for the best method previously employed. Attention has been turned to banana growing as a possible industry, and a collection of 35 varieties has been brought together for further study. Among them are a number of native varieties that have never come into commercial planting, and some of them appear to be very promising. The station has introduced a number of late fruiting avocados to secure a continuous supply of that fruit throughout the year, the ordinary varieties maturing fruit only during the summer season. The avocado has a high content of fat and attempts are being made to utilize surplus fruits in various ways. The Zante currant, or the currant grape of Greece, has been successfully introduced, and an attempt is being made to establish its culture on the semiarid hillsides and mountain sides which are of frequent occurrence throughout the island.

For several years considerable attention has been given to the growing of acid limes, not only to supply local demands but as a possible source of citrate of lime and citric acid for export, and the variety Kusaie has been extensively propagated and distributed as the best for Hawaiian conditions.

The agronomist has given especial attention to the development of coarse forage grasses to be cut green and fed to dairy stock. A rapidly growing plant that can be cut frequently is required for this purpose. It has been found that Uba cane apparently meets the requirements. In cooperation with the Hawaiian Sugar Planters' Experiment Station successful attempts were made to hybridize Uba cane with pollen from some of the best varieties of sugar cane. Uba cane seldom flowers in Hawaii, but the station overcame this difficulty and a number of hybrids are being tested for forage and for sugar production. Considerable attention is being given to crops adapted to rotate with sugar cane and pineapples. Pigeon peas have given very promising results in rotations with pineapples. Sunn hemp (*Crotalaria juncea*) has been found excellent as a green manure crop on exhausted pineapple lands, and demonstrations with it are in progress on the various islands. Hybridizing and selection work with Guam and other varieties of corn and the seedling production of sweet potatoes have given excellent results, and some well-fixed strains have been secured for wide trial by the growers of these crops.

The chemical department has devoted much time to study of the utilization of surplus fruits, vegetables, etc., and has been instrumental in developing a starch industry as well as industries for the preservation of various fruits. Preliminary experiments have shown that there is probably no basis for the rather common belief that locally grown vegetables are deficient in iron and other mineral substances, and that, therefore, imported vegetables have a higher nutritive value.

The extension activities organized in 1914 have been extended to cover all the larger islands, and helpful contacts have been established with various agricultural interests. An agent on the island of Hawaii has charge of the Glenwood demonstration farm and he visited all important localities and assisted in the solution of some of their more pressing difficulties. At the Haleakala demonstration farm on Maui work is in progress to show what crops are adapted to that homestead area, and some assistance has been given to school clubs and home gardeners. Preliminary work with boys' and girls' clubs gave such promising results that a full-time leader to develop this work was appointed in April and a number of clubs have been organized. A part-time collaborator carried on demonstrations of the use of locally grown food products, especially of some of those less widely known, and an average of more than 500 contacts with parents of various nationalities were established monthly. The campaign also included efforts to encourage the wider use of milk and milk products which are not sufficiently used in the diet of many of the people.

### PORTO RICO STATION.

The Porto Rico station is endeavoring to withdraw from the extension field in favor of local agencies and is devoting its energies more and more to the solution of various problems connected with the diversified agriculture of the island. The insular bureau of agriculture is expanding and as rapidly as it is prepared to do so is taking over the extension work, the station being called upon to act as technical adviser and instructor of the various local agents.

Ever since the establishment of the station attention has been given to problems connected with the management of soils under tropical conditions. The former chemist has completed a series of reports on the reaction of soils to various amendments, and in his last contribution gave an account of the efficiency of phosphatic fertilizers in Porto Rican soils as influenced by liming and by the length of time they remain in the soil. The character of the soil was found to materially influence the availability of added phosphates and the effect of the different phosphates varied widely under the conditions of the experiments. The relation of the lime requirement of soils to the efficiency of phosphates was determined for a number of typical soils. In another investigation reported by the chemical department of the station, certain nitrogenous fertilizers were found to favor the development of chlorosis in rice, either through their action on the plant or by rendering the iron in the soil unavailable. Nitrates in general were found less suitable for the fertilization of young rice plants than were the ammonium salts used.

The station continued its efforts for the control of cattle ticks which started with the construction at the station of the first dipping tank on the island. There are now nearly 200 public and private dipping vats in the island and sentiment is believed to have been developed that will result in an eradication campaign by the insular authorities in the near future. Following the cleaning up of individual plantations, the livestock industry, and especially dairying, has received a great impetus and many purebred animals are being introduced. The station showed the value of purebred sires in the upgrading of its dairy herd, which now consists mostly of three-quarters or seven eighths grade Guernseys. The milk production of the grades largely exceeds that of a number of native cows whose records were obtained.

In the rapid development of the cattle industry that has taken place during the last few years the activity of the station in the introduction and dissemination of improved forage plants has played an important part. Napier or elephant grass, Guatemala grass, and velvet beans, all of which were introduced by the station, have proved well adapted to local conditions, and many individual planters now have large acreages of each from which their neighbors can obtain seed and cuttings for planting. Another important introduction was Uba sugar cane, which is not affected by the mosaic disease that is so destructive to many of the varieties commonly grown. The first of this variety of cane grown in Porto Rico was introduced by the station, and extensive trials have shown that in addition to being resistant to the mottling disease, or mosaic, it tillers well and produces a high tonnage of cane. On the higher lands, where the standard varieties can not be grown at a profit, Uba cane is giving excellent results. The station has continued its activities in the production and testing of seedling varieties of sugar cane, and during the current year about 15,000 seedlings were produced from which to make selections. New seedling varieties are rapidly replacing the old ones which have deteriorated from various causes.

In 1909 the station began an experiment in growing vanilla in Porto Rico, and it reports that one planter has now 10 acres of old coffee land planted to vanilla. In 1922 he harvested from 2 acres of vanilla, planted in 1918, and from scattered plantings just coming into bearing, 850 pounds of cured beans for which he received $4 per pound. Vanilla culture has been found quite profitable in connection with the renovation of coffee plantations, and a number of planters are taking up this new industry.

A very satisfactory experiment in the control of citrus scab was conducted during the year. More than 3,000 grapefruit trees were sprayed four times with Bordeaux mixture to which 0.5 per cent of oil emulsion was added, with the result that the sprayed trees produced fruit, 94.4 per cent of which was entirely free from scab as compared with less than 10 per cent clean fruit from the unsprayed trees.

Tobacco manufacturers in Porto Rico often experience heavy losses due to the tobacco, or cigarette, beetle. So great was the damage done by this pest that one of the largest manufacturers of cigars enlisted the station in an investigation of the matter and financed cooperative experiments in the fumigation of all its factories and

warehouses. Examinations made subsequent to the final fumigation showed that the manufactured cigars were free from beetles, as was also the baled tobacco, the hydrocyanic-acid gas having completely penetrated the bales.

The station continued its plant-breeding work along several lines. A very prolific white-seeded strain of a black bean from Venezuela has been obtained. The mango orchard has been extended and the station now has about 60 varieties of introduced mangoes, many of which are coming into bearing. Studies are made of the character of the different fruits and the possibility of their utilization by shipping to the mainland or by canning or preserving. Successful efforts have been made to can mangoes, and a very attractive product that retains its flavor has been produced.

Investigations of some of the factors which influence the price of Porto Rican citrus fruits are in progress, and a large amount of data has been secured on the effect of temperature, humidity, ventilation, and other conditions on the quality of the fruit when it reaches the mainland markets.

### GUAM STATION.

The island of Guam was visited by a destructive typhoon on March 26, 1923, and much damage was done to buildings, fences, and crops. The animal husbandman in charge placed the damage to the station property at $8,000. As the regular appropriation to the station was not sufficient to meet the expense, $5,000 was transferred to the station from department funds, under authority given in the act making appropriations for the department. Immediate temporary repairs were made to protect the station property, and the permanent restoration of the buildings and fences is being pushed as rapidly as materials can be obtained.

During the year the animal husbandman in charge of the station made a visit to the Philippine Islands, where he had opportunity to confer with the insular authorities regarding experiment station matters and to secure a large amount of information and material that it is believed will be of value to Guam. Arrangements were made for the inspection and fumigation of a large quantity of economic plant material that was taken to Guam and provision was also made for future supplies of the same character.

The reduction in the appropriation has made it impossible to fill the positions of agronomist and horticulturist and of extension agent. The work is maintained as far as possible by the animal husbandman in charge, with such assistants as he can obtain locally, none of whom has had much scientific or technical training.

The station continues to be about the only source from which animals for breeding purposes can be obtained, and as a consequence its work in up-breeding horses, cattle, swine, goats, and poultry is being given special attention. One of the greatest difficulties met with in stock raising in Guam, aside from the degenerated stock, is the absence of suitable feeds. In connection with the breeding work, experiments in feeding are in progress with all types of animals to determine the possibility of substituting local feeds that may be available in quantity for the high-priced concentrates that are brought from the States. The results of experiments with horses,

in which copra meal was substituted for part or all of the grain feed, appear to indicate that copra meal can not be substituted for the entire grain ration, but it can replace a portion of it, probably up to 50 per cent. With cattle, copra meal, as a portion of the concentrate, has given economical results, since it can be secured at a very low price. The use of a small amount of concentrate with cows on an exclusive green-forage ration was followed with an increase in milk throughout the entire period of lactation. With swine, a ration consisting of two parts cooked breadfruit, one part damaged rice, and one part copra meal, together with 3 to 4 ounces tankage per head daily, proved a satisfactory ration for dry sows and mature boars during a feeding period of 125 days.

The poultry work has been reduced to experiments in breeding, particularly an attempt to develop a new breed through the crossing of the Rhode Island Red with a selected strain of white native hens. The first cross has resulted in more vigorous and livelier fowls than the Rhode Island Reds but of poor egg-laying qualities. All sorts of colors of plumage were obtained. In the second generation crosses some pure white birds have been secured. The work with purebred Rhode Island Reds is progressing satisfactorily and through continued selection a flock of high producing fowls has been developed. Surplus breeding stock was disposed of through boys' and girls' poultry clubs.

In the forage-crop investigations, grazing and feeding tests were made with Napier, Guatemala, and Para grasses, and Japanese cane. It was found that Napier grass made the quickest growth, and that it should be cut when from 36 to 45 inches in height, otherwise the stems become woody. Guatemala grass remains succulent much longer and may be cut at a much later stage. The season was favorable for the growth of grasses and large yields of green forage were obtained, 83 tons per acre for the third cutting of Guatemala grass and 68.5 tons for the second cutting of Napier grass. Japanese cane gave 87.5 tons for its second cutting.

The corn work was confined to improvement. A four-year selection of Guam white corn yielded at the rate of 26 bushels per acre. A small yellow variety received from the Hawaii Experiment Station yielded at the rate of 41 bushels per acre. Time of planting, variety, and fertilizer tests with rice were continued with varying results. Early planting and the application of nitrogen in the form of ammonium sulphate have given the highest yields. A number of ranchers near the station were induced to try early planting of rice, and yields of as much as 64 bushels of unhulled rice per acre were obtained.

The soil investigations were continued, the effect of continuous cropping and rotation of crops being studied. Pot experiments with old and new soils showed that grasslands of Guam newly brought under cultivation are decidedly acid, and there was an immediate response to the application of lime.

Work with tropical fruits consisted merely of keeping the plantings in as good condition as possible and propagating the better varieties for further planting.

The vegetable work has been reduced to a very small area, the most of the garden tract having been planted to cowpeas.

The extension work that was so successfully carried on for several years had been kept going as well as it was possible without a trained leader to direct it.

### VIRGIN ISLANDS STATIONS.

The residence begun under the administration of the former agronomist in charge was completed, considerable clearing of brush land was done, and pastures were established on land that had not been utilized previously. Some further efforts to secure a larger water supply were made, and eaves troughs were placed on practically all the remaining buildings so as to catch and store in cisterns all the water possible. A beginning was made in the digging of a well, and a small supply of water was secured, but digging was continued in the hope that an adequate supply might be obtained.

The entomologist of the station, C. E. Wilson, resigned August 25, 1922. On May 8, 1922, W. M. Perry was appointed horticultural and extension assistant. He arrived May 22 and at once entered upon his new duties.

The Virgin Islands are again experiencing a below normal rainfall, with the accompanying shortage of crops. For the third year in succession the rainfall on St. Croix has been only about two-thirds of the normal, and for the first three months of 1923 only 5.41 inches were recorded at the station. In the month of May, which has an average of 4.5 inches of rainfall, there was but 0.36 inch in 1923. This has resulted in a serious drought at the station, and all field and plat work has suffered severely.

The experimental work of the station, especially that carried on during the summer season, was handicapped by the dry weather. Cane seedlings, of which the station had many, made slow progress, due to an inadequate water supply, and by reason of the limited supply for watering the young plants many of them died. Of more than 300 seedlings produced in 1922, only about 200 are living. The work with corn suffered in like manner. Efforts were continued to produce a table corn by crossing a native strain with the variety Black Mexican. A hybrid has been secured that appears promising as a table variety and is not susceptible to injury by the corn-ear worm. Every effort was made to save this strain of corn. Other varieties, notably Guam corn, had become so mixed that all were abandoned.

The work of developing new seedling varieties of sweet potatoes has been continued. Of some 250 varieties that were grown to maturity, about 100 are being grown in one-eightieth acre plats in comparison with the parent varieties. This work has not progressed sufficiently to determine the value of the new varieties, but some of them appear quite promising. A number of the varieties were sent to the Bureau of Plant Industry of the department, and they are now growing at the Arlington Experiment Farm.

Variety and culture tests of cowpeas, velvet beans, mung beans, and alfalfa were undertaken with varying success. Poor stands were obtained in most cases, but as the crops have not yet matured no comparisons can be drawn.

In cooperation with the office of forage-crop investigations of the department, a test was made of 11 varieties of sorghums. The va-

rieties differed considerably in their habit of growth, but most of them produced satisfactory growth during the dry weather and matured good crops of seed. Considerable damage was done by caterpillars attacking the heads, the varieties having compact heads suffering the most injury. Fortunately, a brick-red ladybird beetle kept the caterpillars fairly well under control in the field.

The horticultural work consisted of experiments and demonstrations in the production of vegetables and the introduction of new fruits and other valuable plants. In order to encourage the more general planting of the varieties of vegetables that had proved successful at the station, distributions were made of fresh seed or plants of these varieties.

The garden-vegetable work of the station, although conducted under rather adverse weather conditions, was on the whole very encouraging. Plantings were again made throughout the year, but the most propitious time for many vegetables was between November and March. During this period the rainfall was more than the average and the temperature and evaporation were lower than at other times. Insect pests, especially caterpillars, are usually more abundant from August to October than during the rest of the year. Considering the season, satisfactory results were obtained with string beans, Lima beans, eggplant, okra, peppers, tomatoes, Bermuda onions, peas, radishes, turnips, carrots, parsley, mustard, endive, and New Zealand spinach. Again the superiority of certain of the varieties over others was plainly indicated. Beets, chard, celery, and rutabagas were more or less of a failure. Cabbage withstood the hot weather and made small heads, but it and many other plants were severely injured by insects. Where it was possible to use it, dusting with a mixture of lead arsenate, powdered lime, and sulphur gave fairly good control of leaf-eating insects.

The value of starting vegetables in seed beds and transplanting them to the garden after a favorable rain was demonstrated and 48,115 plants were distributed among prospective gardeners. While the results of this distribution were not all that could be desired, vegetables, especially tomatoes and carrots, were reported in the local market to a greater extent than usual.

Some demonstration work in gardening was begun on St. Thomas during the year, and it is hoped to extend this quite rapidly and to make that island less dependent on importations from Tortola for its vegetable supplies.

A considerable number of introductions of economic plants of various kinds were made, many of them through the cooperation of the office of foreign seed and plant introduction of the department, and many of them became established and are growing well even with the low rainfall of the past year. A few grape vines were observed on various plantations in the islands, and the success reported with them led to a collection of local material and the importation of other varieties from the Southern States which were planted late in 1922. The vines are reported to be making some growth, but are beginning to show the effect of a lack of moisture.

Additional data were recorded for the station herd, especially the milk yields of the cows, with a view to beginning experiments in breeding up a dairy herd.

## OFFICE OF COOPERATIVE EXTENSION WORK.

C. B. Smith, *Chief.*

The office of cooperative extension work has maintained its organization as outlined in the report for 1922, consisting of (1) a division of programs, (2) a division of methods, and (3) an administrative division. It is still too early to determine the full merits of the revised plan of office organization. It is probable, however, that both the Washington staff and the staff in the States are thinking more directly of extension tasks to be undertaken and with less concern as to the particular agency involved for their accomplishment than has been the case heretofore. It is very certain that on the whole men agents are giving considerably more attention to home problems than heretofore, and that both men and women agents are giving increased support to the teaching of better practices in agriculture and home economics through juniors as a result of the new plan.

In the Western States there has been a tendency toward centralization of administrative responsibility for the extension program in a county in a single head designated by the extension director. This tendency is growing in the Corn Belt States, but to no apparent extent in the South or in the East. Throughout the whole country there has come fuller recognition of the public character of the county extension agents and of their direct responsibility to the extension directors of the land-grant colleges. Farmers and their wives, however, are being increasingly taken into full partnership with the extension agents in determining the extension program for both the farm and the home, and are functioning in an even larger way in accepting responsibility for carrying out the agreed-upon program.

Probably the most marked development in extension work during 1922–23 was the emphasis the extension service gave to the development of a sound farm and home extension program. In some cases this has taken the form of councils or committees composed of persons at the college and representative farmers and home makers who have gone over the information available and made recommendations upon which the extension program was to be based. In other cases the extension director has delegated one or more persons to bring together the basic facts and material upon which sound extension programs may be based.

It also appears that the extension workers have given a great deal of thought not only to their methods but also to their efficiency as extension workers. The State leaders have analyzed not only the content of the county extension programs, but have studied the activities of the agents to determine how many people came in contact with their ideas, and with their field and other activities, and are thereby influenced to change their practices.

The funds employed in support of extension work carried on by the office of cooperative extension work in cooperation with the States during 1922–23 for all purposes totaled as follows:

| | |
|---|---|
| Washington administration | $214,000 |
| State administration | 1,015,000 |
| County agent work | 9,938,000 |
| Home demonstration work | 3,013,000 |
| Boys' club work | 1,112,000 |
| Extension specialists | 3,239,000 |
| Extension schools, fairs, publications, and miscellaneous | 504,000 |
| Total for all purposes | 19,035,000 |

During 1921–22 the total expenditures for extension work amounted to slightly over $18,000,000. The money has been used, apparently, to better advantage during the past year than in previous years in that the number of county workers is increasing, and the supervising force is being gradually diminished, with the result that there is a larger number of agents having direct contact with the farming people.

The total staff on the pay roll of the office on June 30, 1922 and 1923, for county agricultural agent work, home demonstration agent work, and boys' and girls' club work was as follows:

*Number of cooperative extension employees.*

| | 1922 | 1923 |
|---|---|---|
| County agricultural agent work (men): | | |
| Directors and State leaders | 51 | 56 |
| Assistant State leaders and district agents | 116 | 111 |
| County agents and assistants | 2,124 | 2,158 |
| Local agents (colored) | 162 | 179 |
| Total | 2,453 | 2,504 |
| Home demonstration work (women): | | |
| State leaders | 46 | 43 |
| Assistant State leaders and district agents | 76 | 74 |
| County agents and assistants | 743 | 834 |
| Local agents (colored) | 110 | 104 |
| Total | 975 | 1,055 |
| Boys' and girls' club work (men and women): | | |
| State leaders | 45 | 42 |
| Assistant State leaders | 78 | 60 |
| County leaders | 205 | 153 |
| Total | 328 | 255 |
| Grand total | 3,756 | 3,814 |

In addition to the above the land-grant colleges with which this office is cooperating employed approximately 750 extension specialists dealing with various phases of agriculture and home making.

During the calendar year 1922 there were 885,000 demonstrations by farmers or members of their families, due to the influence of the county agricultural agent, the home demonstration agent, the boys' and girls' club leaders, or the subject-matter specialist. Of this number the county agricultural agents were responsible for 276,500, and of the remainder 358,000 were conducted by club members. Without making any allowance for duplication, 3,800,000 farmers or members of their families adopted new or improved methods of farming and home making as a result of these activities and those of previous years, the work of county agents being responsible for changes in practice in 2,540,000 of these cases.

GENERAL IMPROVEMENT IN PLANS AND METHODS.

The maxim that all programs of extension work should be based on an analysis of local or community needs has been given increasing support, as shown by the greater number of community programs developed throughout the United States. More than 21,000 communities in counties now employing county extension agents have local committees or clubs which join with the extension agents in developing and working out local programs of work. In developing such community programs, however, very definite progress has been made in the direction of securing more specific programs, programs that express more nearly the problems of the people locally. This has been brought about through the close contact with leaders in the various communities and by more thorough analysis. With this has come, also, greater realization of the need for developing in the community a permanent program which includes a limited number of the larger farm and home problems. There has also been a tendency to insure a definite and more widespread adoption of recommended practices, during a reasonably brief and specific period of time, by incorporating in such programs 5-year or 10-year goals.

There has been fine response to the principle that the programs of extension work should express the needs of all rural interests, those of the farm, the home, and the youth of the farm, as well as of farming industries in general. In many States the number of club members enrolled by county agricultural and home demonstration agents as well as of demonstrations carried on in connection with farm and home problems have greatly increased. The agents not only have been more active in demonstrating and working out problems incident to developing more sanitary home conditions and the installation of household conveniences, including water supply, sewerage, lighting systems, and the like, but in counties without home demonstration agents have, with the help of home economics specialists, aided in securing many demonstrations and widespread adoption of practices in connection with such problems as those of clothing, food preservation, rural health, and child nutrition.

In connection with the determination of local and county programs of extension work, county extension agents are testing, as never before, the solutions and recommendations which heretofore have been suggested. This has been necessary because closer contact with the people in a community brings better recognition of local habits, prejudices, economy, equipment, practices, and in general of local needs and conditions. It is being found that it may often be necessary to make adjustments and changes in the recommendations heretofore made in order to secure greater adoption of practices. These local conditions may affect not only the recommendations made but also the kind of teaching carried on.

For example, the use of lime has been recommended for many years. The lack of local conveniences for distributing lime, the high cost of material, and perhaps lack of sufficient proof that the use of lime may be a paying proposition have prevented many people from using lime. When the extension agents help the people to find a convenient way to use lime or to cheapen its cost and by an adequate number of well-placed comparative demonstrations

show that it pays to use lime, it is found that there is a very great increase in the amount of lime used locally. Records are available that show an annual consumption of over 4,000 tons of lime in a county where previously only 150 tons had been used. This came as a result of encouraging the crushing of lime rock found on the farms with portable lime crushers. The great development of spray rings and spray services is another illustration of ways and means that may be found to get people to adopt a practice.

Such considerations have created greater interest in and directed more attention to the study of extension work as a teaching job, with special reference to finding out not only the conditions which may naturally prevent the people from adopting practices, but also those elements or principles of pedagogy and psychology which should be applied in order to bring about widespread interest on the part of the local people and impel them to accept and adopt the better practices. With this has come an appreciation on the part of extension agents of the fact that there are great differences in people, as to their ability to adopt practices, and that the teaching effort needs to be defined in terms of these differing degrees of ability. As a result extension agents are studying the question of breaking up problems into single phases and giving increasing attention to developing the teaching of better practices in terms of single simple practices. For example, instead of attempting to teach at one time all the large principles of orchard management, herd improvement, crop rotation, soil management, poultry management, and the like, the extension agent is giving more attention to teaching and demonstrating single practices as steps in the gradual improvement of an activity or industry. The thinning of fruit, the securing of a purebred sire, the use of lime, the feeding of mash, all may be cited as examples.

With the recognition of the need for teaching by single practices has come also a greater use of project leaders or key demonstrators as extension teachers. This is natural, and with concentration on teaching by single practices the duties and responsibilities of project leaders have become more important and the accomplishments greater in number. The very great progress that has been made by training project leaders in terms of single practices in the field of home demonstration work has directed the attention of specialists and county agents toward adopting the same method in working out agricultural problems. It is being found that the usefulness of project leaders as teachers is most closely connected with the degree to which specialists and county agents have been able to analyze the problem and break this up into simple phases and teach in terms of single practices. Project leaders can be trained in terms of single practices who could not be trained in terms of principles and are then able to teach others in terms of single practices.

This very logically affects the entire effort of extension agents and committeemen in advancing the extension program. There has been an increase in the number of demonstrations reported by county extension agents during the year, not only because the agents realize more and more the part demonstrations may play in teaching the value of recommended practices, but because more simple demonstrations have been designed. It is quite obvious that simple demonstra-

tions can be more effectively supervised and that a larger number may be conducted by the agent. There has come, too, a tendency on the part of the agents to make the demonstration teaching period more definite. By doing so the number of demonstrations carried on in any one year has been increased and by thus concentrating on single problems a wider adoption of practices may be more quickly secured. Very naturally, too, there has come a wider use of demonstration meetings, tours, and excursions of people locally to see the results of demonstrations.

The year has also been marked by an increased use of motion-picture films, charts, posters, project exhibits, and other illustrative material. The use of motion pictures in particular has received greater attention. The results secured in certain campaigns, such as campaigns for purebred sires, control of insect pests, and eradication of tuberculosis, have been very much increased by the wide use of certain films in connection with such campaigns.

The old type of campaign is changing and a more effective type is now being given attention by county agricultural agents. This follows the realization that the teaching effort may properly be divided, for most people, into three stages; that is, (1) developing interest and attention, (2) awakening confidence and desire, and (3) impelling decision and action. By outlining the plans of work for any project so that the first two are secured through the adequate and well planned use of demonstrations, demonstration meetings, tours, exhibits, illustrative material, trained project leaders, and publicity, the demonstration or teaching period may be terminated more quickly and be merged with or followed by a campaign period in which a more intensive use is made of the records and results secured in the demonstration and teaching period to induce a definite adoption of practices on the part of a fairly large number of people.

In such campaigns definite attempts are made to secure pledges from people that they will adopt the practices recommended. Enrollment of such cooperators is secured through personal letters, circular letters, publicity, at subject-matter meetings, or through the efforts of local project leaders. This may be done at the demonstration meeting or at the time that programs for another year are being made up and project leaders and demonstrators give local testimony to the worth of the practices which have been demonstrated. In many ways it seems as if this stage completes a chain which heretofore has been broken.

The programs of supervision are becoming less general and include to an increasing extent the training of county agricultural agents in terms of methods, and particularly in terms of the methods and plans of work needed in each specific case. The problems of securing balanced, unified, workable programs, organizing for extension work, planning for more definite and local use of extension methods, as well as measuring results, are given the very earnest attention of supervisors. In consequence there is more effective local use of extension organizations and the extension service and a larger degree of accomplishment in terms of practices adopted by the people.

SOME RESULTS OF COUNTY AGRICULTURAL AGENT WORK.

A few concrete results of extension work along agricultural lines may be cited.

*Soils.*—During 1922, 213,000 farmers consulted the agents regarding the use of commercial fertilizers. In addition the farmers conducted 15,235 fertilizer and 4,035 lime demonstrations. As a result of the activities in connection with lime 48,000 farmers used 630,000 tons according to the methods advocated by the agents. In addition to the above, 105,000 farmers modified their methods of soil management. In order to maintain and improve soil conditions, 3,750 drainage systems, involving 575,000 acres, and 29,000 pieces of terracing, involving 445,000 acres, were carried out according to the methods outlined by the extension forces.

*Cereals.*—One of the phases of extension work reaching the largest number of farmers is that relating to corn. During the year 13,155 farmers cooperated with the agents in conducting corn demonstrations and 16,350 boys and girls grew 23,000 acres of corn according to the methods advocated by their leaders and made satisfactory reports. As the result of these activities and similar activities in previous years, 275,000 farmers changed their methods of corn production. Of this number 48,000 tested 170,000 bushels of seed and 108,000 selected their seed corn in the field, 6,875 grew and offered for sale 325,000 bushels of improved seed corn, and 27,300 were influenced through the extension work to purchase 120,000 bushels of such seed. In 1922, 7,500 farmers conducted demonstrations in methods of growing and handling wheat and 90,000 were influenced to change their method of wheat production, a part of whom treated 1,235,000 bushels of wheat for smut, thereby increasing their yields from 3 to 5 bushels per acre. A total of 7,876 farmers produced 1,390,000 bushels of seed wheat for sale and the extension agents were successful in inducing 24,000 to secure 610,000 bushels of this seed.

The work with oats was similar to that with wheat in that it was devoted primarily to inducing farmers to purchase improved seed and to give their seed treatment for smut prevention, 5,500 farmers completing their demonstrations and 70,000 following one or more of the practices which the county agent had been advocating with reference to oat production. Of these, 30,000 were reported to have treated 750,000 bushels of oats for smut, and 3,850 offered 780,000 bushels of improved oat seed for sale and reported that 14,400 purchased 385,000 bushels of such seed.

*Hay and forage.*—Next to corn, hay is one of the most universally grown crops. The interest of the farmers in extension work with legumes and better varieties of hay and forage continues. In 1922, 4,663 farmers cooperated with the agents in alfalfa demonstrations, 8,086 in soy bean demonstrations, 2,084 in velvet bean demonstrations, 4,107 in cowpea demonstrations, 1,324 in crimson clover demonstrations, and 3,833 in sweet clover demonstrations. As a result of these activities 38,300 farmers either grew alfalfa for the first time or improved their methods; 56,820 grew soy beans; 16,375, velvet beans; 23,400, cowpeas; 10,840, crimson clover; and 20,250, sweet clover. During the year approximately 250,000 farm practices, with reference to the growing of legumes or other forage crops, were modified.

*Cotton.*—The extension agents report that cotton demonstrations were conducted in 4,320 communities and that 11,300 farmers were enrolled as demonstrators, of whom 6,500 completed their work, using improved methods on 180,000 acres. In addition, 38,250 farmers observed these demonstrations and conferred with the agents in the use of similar improved methods on 615,000 acres, 5,200 reported that they tested 75,000 bushels of cottonseed for germination, and 850 planted 195,000 acres with selected seed cotton. The agents also induced 10,500 farmers to select their seed cotton in the fall. Although they changed the cotton practices of 52,000 farmers during 1922, and 4,025 farmers produced for sale 11,230,000 pounds of seed cotton and 27,200 secured 8,350,000 pounds of such seed. During 1922, 4,116 boys enrolled in the junior cotton clubs, of whom 1,820 reported the value of the crop of their 3,390 acres at $137,000.

*Potatoes.*—The work with potatoes continues to be of interest not only to the adult farmer but to the boys' and girls' club members. Altogether 11,600 farmers completed their potato demonstrations, 6,963 completed satisfactory potato club work, and 150,000 changed their practices as the result of extension activities during 1922. There were 5,800 sweet potato demonstrations by 1,450 boys and girls, 19,500 farmers improved their methods of sweet potato culture, 7,880 offered 2,260,000 bushels of seed potatoes for sale, and 43,350 purchased 922,000 bushels.

*Horticulture.*—The horticultural work as at present conducted appears to be of unusual interest not only to the farmer and his wife but to the boys and girls. During the year 19,600 orchard demonstrations were conducted and 4,859 boys and girls completed the requirements of fruit clubs. On 116,000 farms orchards were either set out or methods of orchard management were changed. In all, 85,000 demonstrations relating to small fruits were conducted. As a result of these activities 296,000 acres were sprayed and 214,000 acres pruned according to the methods advocated by the agents.

*Rodent pest control.*—In the Rocky Mountain States, and those bordering on them, the farmers have suffered large losses because of destruction of crops and livestock by certain rodents and predatory animals. In 1922, 75,000 farmers joined in an organized effort to control these pests and 1,370,000 pounds of poison bait were used on 13,300,000 acres.

*Grasshoppers.*—Another phase of extension work which has had a marked influence in increasing yields has been campaigns to clear the land of grasshoppers and other injurious insects. During 1922, 69,000 farmers cooperated in clearing 27,000,000 acres, using 10,000,000 pounds of poison bait. Most of this work was carried on in the wheat-growing area.

*Livestock.*—The work with livestock continues to be one of the phases of farming that is of increasing interest not only to the adults but of peculiar interest to boys and girls. For example, there were altogether 4,410 demonstrations relating to dairying, while the number of boys and girls completing work in dairy clubs was 12,500. There were 1,100 beef-cattle demonstrations reported, yet the total enrollment of boys and girls in beef clubs was 3,900. The number of swine demonstrations reported was 38,715 and the enrollment in swine clubs was 32,400. As a result, 74,000 farmers improved their

methods of swine production. The adult demonstrations in connection with poultry were 33,400, with a club completion of 45,000. During the year 170,000 persons were thus led to improve their methods of poultry production. The number changing their farm practices with reference to poultry was greater than for any other productive farm enterprise.

The agents report that in 1922, as a result of their suggestions and advice, 7,800 purebred dairy bulls and 15,000 purebred dairy cows, 7,500 purebred beef bulls, 6,700 purebred beef cows, 14,900 purebred boars, 40,750 purebred sows, 3,300 purebred rams, and 6,200 purebred ewes were purchased. The county agents cooperating with the Bureau of Animal Industry continued to take an active interest in the better livestock campaign. The reports indicate that at present there are 8,925 farmers who have enrolled 150,000 head of cattle, 105,000 head of sheep, 87,000 head of swine, 18,000 head of horses, or 360,000 animals, of which 144,000 are purebred, as well as 720,000 head of poultry.

The spread of the cooperative bull associations has been such that in 1922 there were 190 active associations with a membership of 6,100 farmers owning 860 bulls, 7,125 purebred cows, and 33,500 other cows.

The organization of farmers into cow-testing associations in order to secure a more profitable output and to determine which are the more productive animals continues to prove successful. The number of associations increased during 1922 by more than 50 over the previous year. The present records show that there are 513 active associations with an enrollment of 12,510 farmers owning 220,000 cows.

*Livestock diseases.*—The county agents were very active during the year in attempting to prevent the large losses of livestock from diseases and various kinds of pests. Altogether, 1,520,000 head of cattle were treated for tuberculosis and 440,000 were inoculated for blackleg, and 980,000 hogs treated for cholera. Over 4,000,000 were treated for various livestock diseases either upon the advice of the agent or as a result of previous demonstrations.

*Agricultural economics.*—Although the work in the field of agricultural economics has not been put on a demonstration basis to the same extent as other types of agricultural activities, it has resulted in improving agricultural practices to a marked degree. During 1922, 84,000 farmers changed their farm enterprises or improved their livestock and cropping systems, and 940,000 farmers or members of their families joined marketing organizations or were aided in the disposition of their crops or the purchase of supplies by the extension service, which resulted in a total business of over $260,000,000, or a saving of nearly $18,000,000 to the farmers.

### SOME RESULTS OF HOME DEMONSTRATION WORK.

Home demonstration agents concerned themselves as usual in promoting better practices in the various phases of home economics and such additional matters as poultry, dairying, gardening, home beautification, community betterment, marketing, and like matters touching the home or increasing the wife's income.

During the year 430 of the home demonstration agents reported that the farm women cooperated with them in conducting 26,650 demonstrations relating to gardens, over 10,000 on topics relating to flowers, 4,800 relating to the vineyard and small fruits and an equal number relating to the home orchard. As a result of these activities 84,300 gardens, 14,530 orchards and groves, and 18,400 vineyards were improved, and the home grounds were beautified in 31,260 instances.

The work with poultry continues to be one of the activities in which the home demonstration agents participate largely. During the year 24,000 demonstrations were conducted with chickens and 2,300 with other kinds of poultry, resulting in the changing of the poultry practices on 92,375 farms. As an outcome of these activities 184,000 standard-bred chickens were purchased; 20,000 flocks aggregating 1,360,000 birds, were culled, with the elimination of 385,000 birds. The women also preserved 154,000 dozen eggs and sold nearly 500,000 dozen cooperatively.

In certain parts of the country home demonstration agents have been active in introducing the dairy cow in order to provide a supply of milk for the home and to increase the income of the farm women. During the year there were 11,500 demonstrations relating to dairying, which resulted in 3,650 home dairy cows being purchased, and improved methods were used in the making of 3,200,000 pounds of butter, of which 1,260,000 pounds were sold for $425,000. Not only was the farm income increased as a result of these activities, but the children in many farm homes were better nourished.

*Food preservation.*—The two most popular phases of work relating to the home are canning and clothing. In 1922 there were 38,700 demonstrations with reference to the method of canning, 46,700 boys and girls completed canning-club requirements, and 160,000 farm women improved their methods of canning. Another type of work that is proving of interest and value to the farming people is the preservation of meat. During the year there were 12,000 meat demonstrations, and 44,000 homes either canned meat for the first time or improved their methods. There was also considerable work with methods of preserving through drying or brining and of storing food products. As a result of such activities 15,600,000 quart containers of fruit and vegetables were preserved, and in addition 2,000,000 pounds of sausage, 12,000,000 pounds of pork, 1,500,000 pounds of lard, and 940,000 pounds of beef were cared for according to the methods advocated by the extension agents.

*Nutrition.*—The food-preparation work appealed to the farm women to the extent that 13,000 demonstrations were given, 24,000 boys and girls were enrolled in food-preparation clubs, and 75,600 women improved their methods of food preparation. There were also 2,750 demonstrations relating to food selection, and 3,800 boys and girls enrolled in clubs dealing with the project, and as a result 18,375 homes select their food with greater care and in such a way as to furnish a more adequate diet for the family. Reports show that 300,000 children of school age improved their health by the increased consumption of milk and a more suitable diet.

*Clothing.*—There were 8,000 demonstrations dealing with the construction of clothing, which resulted in 48,000 women improving

their methods of dressmaking. There were 7,820 millinery demonstrations, resulting in 22,200 women either making their own hats or improving their methods. There were 13,500 demonstrations with reference to the making and use of dress forms. The information was passed on effectively to 53,200 other farm families. There were also 78,600 boys and girls completing clothing club work. The number of garments made or remodeled as a result of these activities was reported to be 650,000.

*Home conveniences.*—A total of 1,350 demonstrations were conducted in household equipment, changing the practices of nearly 25,000 homes. In addition there were 14,700 demonstrations relating to various phases of home management, which resulted in 40,000 homes changing their present household methods. As a result of these activities there were installed 1,766 water systems, 901 sewer systems, and 584 lighting plants; 13,400 homes were screened and 4,300 remodeled; and 600 homes were improved by new plans and rearrangements of buildings and better care of the lawn. They also influenced 25,000 farm families to improve their sanitary surroundings, 1,900 to purchase washing machines, 4,400 to buy fireless cookers, and 3,800 to secure pressure cookers and canners.

### BOYS' AND GIRLS' CLUB WORK.

In 1923, 28,200 clubs made up of 600,957 boys and girls engaged in demonstration work in agriculture and home economics, an increase of about 12 per cent over the previous year. This shows that State and county extension workers have improved their methods of securing the interest of young people in demonstration work. The other index figure, namely, the number of boys and girls completing demonstrations, amounted to 358,090, or 59 per cent of those who started enterprises. This figure is the best criterion of the quality of the methods employed by extension agents and indicates a decided improvement in 1923. More of the practices demonstrated spread to neighboring farms and were established in the regular farm practices than in any previous year. These three main lines of improvement have come about through a more intensive application of extension workers to the science of extension teaching.

A large number of counties undertook for the first time during the past year to make provision for boys' and girls' club work in the community and county extension programs of work as a means of dealing with particular problems. These community programs of work were built on the basis of problems found through intensive study, careful observation, and use of all available statistics.

The demonstrations carried out by boys and girls were on the whole simpler in 1923 than previously. Heretofore it has been assumed that all of the practices involved in an enterprise, such as the raising of a litter of pigs, were to be demonstrated, but recently in a considerable number of counties boys and girls, while carrying out the entire enterprise, concentrated their effort as a club on a specific practice especially designed to meet a particular community problem. The enterprises which boys and girls carried out in 1922 were larger in a number of lines than in any previous year. This is particularly true in potato growing, swine raising, poultry, clothing, and bread work. These larger enterprises have proved to be more convincing to the community than the smaller undertakings.

Perhaps the one factor most influencing the quality of the club demonstration work the past year has been the improved quality of local leadership. State and county workers have given more thought and time to the training of local people guiding boys and girls than in any previous year. These training conferences were characterized in two ways, namely: (1) Development of local leaders' plans of work at joint conferences; (2) training in subject matter, largely by State specialists.

It is evident that a wider use was made of the means of establishing on farms the practices demonstrated. Team demonstrations have been designed to carry to their respective communities the results of the demonstrations carried out on the home farm. Accordingly, first consideration has been given to the influence of the teams on local farming, and home making and State and interstate competition between teams has been secondary.

The estimated total value of club products was $8,650,000. The largest enrollment was in connection with the work on clothing, which consisted of 123,600 boys and girls, of whom 78,600 completed their work and made nearly 300,000 garments. Next in importance was the enrollment in poultry clubs, which was approximately 80,000, of whom 44,675 completed their work and indicated that they handled 940,000 birds and produced 1,357,000 dozen eggs according to methods advocated by the extension agents. The enrollment in the food preservation clubs was 78,000, of whom 46,700 reported that they canned 2,900,000 quarts of fruits and vegetables. The enrollment in garden clubs was 71,165, of whom 45,400 cultivated 2,321 acres of garden valued at $470,000.

### EXTENSION SPECIALISTS.

Extension specialists are a vital part of the extension system. They aim to keep the agricultural agents, home demonstration agents, and boys' and girls' club agents who work in the counties informed and efficient in the respective lines of subject matter each represents. They also aid the extension director in sizing up the agricultural home problems along each of the various lines in the State and suggest plans for meeting them. They are especially valuable in training community project leaders or key demonstrators in the details of their work. The results of extension work in the counties are in substantial measure due to the assistance of extension specialists.

The following are a few examples of the rather outstanding methods used by extension specialists in the States along various lines of subject-matter extension work:

### GENERAL CAMPAIGN METHODS.

New plans have been developed in Maine to secure adoption of practices following the demonstration period.

Four rather distinct steps in the program of developing the work of extension specialists which have been followed in Maine are as follows:

(1) Determining the fundamental problem needing solution.

(2) Determining the practical and the economic solution of this problem.

(3) The demonstration, or teaching step, to show people on their own farms that the remedy recommended is adaptable to their conditions.

(4) The selling campaign, to secure adoption of the practice by a majority of the people who should be interested.

In developing a campaign, use is being made of good publicity to bring before the people the work that is to be done and the methods that will be followed in the campaign; to enlist the interest and the cooperation of business organizations in order to make easily available the material necessary for the work; and to secure in writing the agreement of the people to carry the work through as worked out by the specialist and the county agent in cooperation with the local people.

In order to bring the people to a clear understanding of the work and to secure their agreement to carry on their part, meetings are held, and these are usually followed by a house-to-house canvass to get in touch with those not reached through the meetings. A circular letter, finally, is sent to all people in the county who should be interested in the campaign. In this way the extension workers have been able in a number of campaigns to secure adoption of recommended practice by from 40 to 60 per cent of those who should be interested in the work in the county.

### FARM FORESTRY.

Substantial development of methods in farm forestry have been worked out in New York State. There are now a number of farm wood lots under some kind of management and plantations in various stages of growth, dating back occasionally for nearly 20 years. Tours to some of the more interesting wood lots and plantations serve to develop interest and to stimulate activity on the part of the landowners.

With this as a beginning, the county agent and the subject-matter leader are able to conduct campaigns through publicity, lectures, and circular letters working toward the establishment of forest-planting demonstrations. In Jefferson County, N. Y., this worked so satisfactorily that the county agent was able to look after the establishment of the plantations without any further personal assistance from the specialist than that given at the time of the tour.

During the spring of 1923 county agents in 39 counties were responsible for over 200 demonstrations, at which a total of over 400,000 forest trees were set out.

### PLANT PATHOLOGY.

During the year very serious consideration was given by State workers to methods of securing general adoption of plant-disease control measures. The number of States maintaining plant-pathology projects has increased, and from the point of view of methods used in planning, organizing, and teaching certain pieces of work have been conspicuously good.

In the field of extension methods, especially noteworthy are the building up of spray information services; the development of means for securing wholesale treatment of seed by dealers and by community growers' associations; arrangements for maintaining

disease-resistant stocks of certain seeds, either by cooperation with seedsmen or by means of seed-increase plats at the college; and the perfecting of plans for training farmers in the fundamentals of plant-disease control.

Throughout all of this work there has been a growing realization of the necessity for cooperation with extension specialists in other lines and for maintenance of close contact with research workers.

### HORTICULTURE.

*Strawberry clubs in Illinois.*—In launching the boys' and girls' strawberry clubs in Illinois, publicity regarding the organization of the clubs was started through the Extension News Service and the Farm Bureau News Letter. Local papers soon took up the matter, and in a few weeks the whole State knew that strawberry clubs were soon to be started. Boys and girls interested in the project were directed to write to the club specialist or to the horticultural department at Urbana for membership application forms. The forms were filled out by the boys and girls and were returned to Urbana with the money for the number of plants desired. Arrangements were made with nurserymen to furnish all the plants at a low rate and to mail each order direct to the club member. There were 739 club members engaged in this work, and 228,900 plants were used.

*Fruit fertilizer work in Michigan.*—The State fruit specialist decided that the greatest need in the fruit industry was that of feeding the fruit trees, grapevines, and bush fruits. He therefore presented his project to the county agents, 23 of whom entered enthusiastically into the plan. With the aid of local committees and associations, the county agent and the fruit specialist selected the demonstrators, the orchards, berry patches, and vineyards to be used. The fruit specialist advised the amounts of fertilizer needed, the demonstrator bought it, and the county agent supervised its application. In some of the counties there were as many as 20 fertilizer demonstrations, and in two years the use of nitrogen fertilizer in the State increased from 100 to 2,500 tons.

### FARM MANAGEMENT.

In the farm management extension work there has been a broadening toward improved means and methods for using basic economic material affecting the business side of farming. The work designed to teach farmers how to keep simple farm accounts and make use of these accounts in determining profitable changes in their business has been materially strengthened through improved methods of organizing and conducting the work. The farm-account summarizing schools where groups of farmers get together and summarize and analyze their annual accounts have passed the experimental stage. Such schools are now recognized and recommended as a practical and effective means of assisting groups of farmers in improving their business organization or practice. A total of 893 farm management schools, with an attendance of 24,253, were conducted during the past year.

Several of the States have selected a limited number of important types of farming areas in which the accounts kept by farmers from not less than 20 farms will be summarized and analyzed for extension

use. A few such area demonstrations have been under way for several years and many additional areas were selected and records started the past year. In 98 areas 2,680 farmers are cooperating in this work. The data from such areas will serve as follows: (1) As a standard for comparison of farm management methods and practices; (2) as a source of material for tours, exhibits, and other publicity; and (3) as a basis for assisting in the formation of county programs of extension work.

In all, 62,734 farmers were assisted in obtaining a simple farm account book for their use, and 2,679 farm account books and 2,026 farm analysis survey records were summarized for extension use. A large number of crop and livestock enterprise records were obtained by farmers, and 2,159 records that were kept through the year were secured and summarized for demonstrational purposes. In addition, 1,612 crop and livestock records were secured for use by the survey method. County agents reported 11,927 farmers keeping an account in the book supplied by the extension service, and 16,162 farmers assisted in keeping cost of production records. They also reported 12,412 other farmers adopting cropping, livestock, or complete farming systems according to recommendations. In all, the farm management demonstrators reported a total of 2,400 meetings, schools, and tours, with an attendance of 92,602.

To give additional aid in promoting the development of county extension programs along sound economic lines, as well as to assist in the correlation of work along commodity lines, the farm management demonstrators are placing increased emphasis upon the summary and analysis of census and other statistical information.

To aid farmers in more accurately adjusting production of the various crops and kinds of livestock to probable demand, economic facts are supplied regarding the leading enterprises included in the county extension program of work. Such facts are prepared and made available for assistance to the farmers (1) in obtaining a better understanding of the fundamental principles which determine prices, and (2) in a better knowledge of the present economic situation regarding particular enterprises with reference to supply and demand and the place of the enterprise in the locality.

Farm management work with young people is being increased through farm accounting with boys' and girls' clubs and through increased teaching of this subject in the rural schools.

The farm management demonstrators during the past year have rather carefully taken stock of the work in view of the past 10 years' experience, with special reference to (1) the objectives of the work, (2) the best means and methods of extension, and (3) the best means of measuring as well as increasing progress, with a view to the development of a more definite and balanced long-time program. This is resulting in a more systematic organization of the work and in greater simplicity of teaching methods.

### FARMERS' INSTITUTES.

Broadly speaking, farmers' institutes are gradually coming to revolve more and more about the county demonstration program, with mutual benefit, especially as regards the spread of influence or adaptation of the teachings of the institutes and of the demon-

strations, as well as in awakening interest in and focusing sentiment on a project.

During the fiscal year ended June 30, 1922, the extension divisions of the agricultural colleges in 16 States conducted 2,614 farmers' institutes which lasted 3,580 days, comprised 7,791 sessions, with an attendance of 1,099,308. There were employed 734 lecturers, 340 of whom were regular employees of the extension staff, and 394 were from outside sources. These institutes cost $134,306.01, of which sum the States appropriated $94,575.35, while the remainder, $39,730.66, was contributed from outside sources, mostly from the farmers themselves. These figures show an increase over the previous year of 1,117 sessions and 353,651 in attendance.

Farmers' institutes were also conducted during the year by other agencies in seven States. These meetings were independent of extension divisions of colleges of agriculture, but in some instances were in close cooperation with them, and usually considerable aid was given by the colleges and experiment stations in furnishing members of their staffs as lecturers or demonstrators. These seven States held 910 farmers' institutes, occupying 1,245 days, with 2,674 sessions and with 479,564 persons in attendance. They used 392 lecturers, of whom 154 were from the colleges or experiment stations, and 238 were from the regular official institute force. The cost of these State institutes was $35,437.05, the State appropriation expended amounting to $35,127.25, with $309.80 additional funds from other sources. Farmers' institutes as conducted by the States, therefore, show a decrease both in number of sessions and in attendance. This decrease is largely due to farmers' institute work having been discontinued in Pennsylvania, Texas, and Massachusetts and no institutes having been held during the year in Delaware, Kentucky, and New Hampshire.

In principle farmers' institutes are not declining, but on the contrary are increasing, although in many instances their work is reported under other names and hence is not recorded as such in the statistics of extension work. There will always be a place, however, for the farmers' institute in any well worked-out extension program.

### NEGRO WORK.

During the year there was an increase of 21 in the number of negro men agents and of 14 in negro women agents, making a total increase of 35.

It is natural that the demonstrations should relate primarily to such crops as cotton and corn. The agents report that they enrolled 3,750 farmers as demonstrators in corn production, of which 2,800 completed their work in growing 25,750 acres of corn according to the methods advocated by the agents. In addition, 18,500 other farmers cooperated in growing 132,000 acres of corn following one or more of the practices advocated by the agents. This resulted in 20,000 other farmers changing their methods of corn production.

Of the 2,050 colored demonstrators enrolled in cotton work, 1,500 completed their activities on 15,000 acres, and 8,000 other negro farmers grew 45,000 acres in which one or more of the recommended practices were adopted.

Many of the agents indicate that negro farmers are improving the quality of their land by growing leguminous crops, better care of manure, and the use of better methods of cultivation and implements. These agents were also influential in encouraging the negro farmers to purchase better stock to be used in improving their herds and also to improve their farm and home buildings. This is indicated by the fact that 6,000 buildings were painted or whitewashed, 4,500 farm buildings were improved, 2,500 new buildings were erected, the sanitary conditions on 8,420 farms were improved, and the home grounds in 5,320 instances were fixed up.

The colored women agents enrolled 24,000 girls and 23,000 women, of whom in each instance 16,000 completed their records. Altogether the girls completed demonstrations in connection with 43,570 projects and the women in connection with 56,500 projects, and 160,000 other girls and women were influenced to change their methods of home making.

The principal activities were those relating to the conservation of fruits and vegetables, in which 13,440 girls and 15,000 women participated as demonstrators, influencing the practices of 30,000 other homes. Next in importance was the garden work, in which 9,200 girls and 10,000 women were enrolled and resulted in starting or improving gardens on 25,000 other farms; 4,600 girls and 7,500 women were also active in carrying on extension work with poultry and were an effective means of changing poultry practices on 8,800 other farms.

### THE OUTLOOK.

With the maximum funds now available under the matured Smith-Lever Act, extension directors are taking stock of their extension organizations and ability to accomplish results. Rapid expansion is being replaced by introspection. The extension program, its development and carrying out so as to reach the maximum of farms, is being studied critically. Standards of work and methods of measuring results are being given attention. With about three-fourths of the agricultural counties having county agricultural agents, one-third having home demonstration agents, and one-tenth having county club agents, the extension system may be regarded as about one-half completed. As time goes on and each line of work more fully proves itself, further expansion will undoubtedly follow. Just now there is a halt in expansion which will probably continue until the research work upon which extension work is based is more adequately financed.

## OFFICE OF HOME ECONOMICS.

C. F. LANGWORTHY, *Chief.*

The Office of Home Economics was from the first authorized to study and to disseminate information concerning the utilization in the home of agricultural products for food, clothing, and other household purposes and the labor incident to their use. This has determined the character of the work during the past year, as heretofore. It has included problems pertaining to food selection, preparation, and preservation; to household labor, particularly

as regards the energy expended by women in various household tasks; and to the consumption of the various classes of goods in the household. One outcome of this last phase of the work is the increasing realization of the importance of economic data in the consideration of home-economics problems. Various features of work of the office during the year were as follows:

Results of experiments with various fruit jellies made with and without pectin extracts from citrus peel or apples were used as a basis for Department Circular 254, "Homemade apple and citrus pectin extracts and their use in jelly making," which was published during the year. Continuing this work, an effort was made to find a household method of extracting the citrus peel in acid solution which would increase the pectin yield. Lemon juice, citric acid, and tartaric acid were compared as to suitability for this purpose. There were found to be great discrepancies between apparent pectin content as indicated by the amount of alcohol precipitate and jellying power. In autoclave extracts the alcohol precipitate determined in the usual way was from 60 to more than 100 per cent higher, whereas the jellying power was from 25 to 100 per cent lower, than in comparable extracts from the same materials prepared in the open kettle. The percentage of alcohol precipitate in lemon extracts is considerably lower than that in orange extracts, yet the jellying power of lemon extracts is about 20 per cent higher. A paper reporting this work was prepared for publication.

Determinations of internal temperature of cooked foods were continued, rates of heat penetration through different kinds of animal tissue being compared. The cause of discrepancies in published reports as to relative rates of penetration into the bone and fatty and muscular tissues was ascertained. These facts have a bearing upon time-tables for the cooking of different cuts of meat of different sizes in the oven and in fireless and pressure cookers, as well as upon destruction of animal parasites and toxins and possibly vitamins. The internal temperatures necessary for certain color changes denoted by the terms "rare," "medium," and "well done," were ascertained for leg-of-lamb roasts, and for lamb, beef, and veal chops, steaks, and cutlets of varying conditions and sizes cooked by different methods. It was shown that the quantity of heat penetrating the tissue rather than the final temperature attained internally is often the effective factor. Determinations of internal temperature are being continued with eggs cooked in different ways and with various batters and doughs.

An instrument for making numerical records of the breaking strength and crushing strength of experimental pastries is being designed.

A paper on methods of determining consistency of culinary fats was prepared as a result of cooperative work with the Bureau of Standards.

Studies of the best ways of improving the bread made by home methods from certain types of soft winter-wheat flour are in progress. Five separate factors have been segregated, which are of particular importance in case of these weaker flours.

Methods of cooking vegetables continued to receive attention from the standpoint of nutritive and table qualities. In cooperation with

specialists of the Bureau of Plant Industry, some of the less widely used kinds and varieties of vegetables, particularly the green-leaf vegetables, believed to be of special importance dietetically, were tested with a view to supplying data which should be useful in preparing gardening and canning budgets for the rural household.

In other experiments mayonnaise dressings were made according to three formulas, using eggs under one week old; eggs 10 months old, unprocessed; and eggs 10 months old, processed in hot oil according to common commercial methods. The processed eggs seemed as effective as the fresh ones, so far as tendency of the emulsion to keep without separating during storage is concerned, but the unprocessed eggs 10 months old were by no means so effective. Seven egg substitutes were compared with yolk and with whole egg as stabilizers in making mayonnaise. It was found possible to retain the form of a coarse emulsion containing as much as 360 parts by weight of oil to 60 parts of vinegar and 1 part of egg (yolk or white), although the emulsion very slowly and gradually separated on standing. However, there need be no sharp or sudden breaking point of the emulsion with increase of oil, provided precautions be taken to keep the oil-to-vinegar ratio about 5 or 6 to 1.

Experiments carried on in cooperation with the Bureau of Standards to determine the effect of aging on various kinds of rubber rings for glass jars were completed, showing that the present specifications are sufficient to insure a good quality of rings. Within a period of one year after date of testing it is safe to use those rings which pass the specifications.

At the request of the American Home Economics Association, a study of variations in the volume of half-pint household metal and glass measuring cups was undertaken in cooperation with the Bureau of Standards. A questionnaire relating to specifications for household measuring cups was sent to home economics departments throughout the country, and a report summarizing 40 replies was prepared.

Six kerosene stoves representing different common types were put through 10 separate tests, including the preparation of two different meals, designed to determine the degree of efficiency attainable in different baking and cooking tasks. The Bureau of Standards cooperated in making analyses of the combustion products for carbon monoxid. Additional measurements of gas consumption in cooking processes were also made.

Other investigations conducted during the year in the experimental kitchen include cooking tests of 38 samples of macaroni and spaghetti pastes submitted by the North Dakota Agricultural College; a study of some of the important factors involved in the making of vanilla ice cream by household methods, and their influence on texture and richness of the product; the development of a standardized process for testing the cooking qualities of almond pastes prepared by the Bureau of Plant Industry; and additional work on the canning of vegetables.

The investigation of methods of home canning were continued. Bacteriological examinations were made of several samples of meat, fish, and oysters that had been canned by home methods and then kept in storage at room temperature for six years. Further work

was done on the morphology and cultural characteristics of different species of bacteria isolated from home-canned vegetables. Preliminary experiments were carried out on the effect of hydrogen-ion concentration of culture media on the growth and thermal death points of bacteria in canned vegetables. The results of these investigations indicate clearly that the spoilage of home-canned vegetables in the majority of cases is caused by germination in the cans of spores of gas-forming butyric acid bacteria. The successful canning of vegetables depends on the sterilization of the contents of the can during processing, or the exclusion of anaerobic spore-forming bacteria by careful selection, preparation, and packing of the vegetables, or on the failure of spores or anaerobes to develop in the can during storage. The latter undoubtedly happens in some cases, since these spore-forming anaerobes have been isolated in a few instances from canned vegetables in good condition.

The studies begun last year on the digestibility of various raw starchy food materials with women as subjects were completed. Tests were made with the following nine materials: Separated corn, wheat, and potato starches, wheat flour, wheat farina, graham flour, corn flour, fine hominy, and ground so-called soft corn or waxy maize. The wheat and corn starches eaten as such were completely digested, and a high coefficient of digestibility was noted with the wheat and corn products rich in starch. It was found that the carbohydrate which constitutes the major portion of waxy maize was almost completely digested. A bulletin summarizing the results of these experiments was prepared for publication.

Respiration calorimeter studies on energy expenditure in household tasks, particularly sweeping and ironing, were continued. The average energy expenditure per hour for sweeping a bare floor was found to be 57.5 calories as compared with 61 calories in case of a pile carpet. In ironing clothes the expenditure ranged from 24.9 calories per hour when the working surface was 82 centimeters (32.28 inches) high, to 30.1 calories when the working surface was 67 centimeters (26.37 inches) high, and to 29.7 when it was 89 centimeters (35.03 inches) high. Such studies showed that the height of the working surface influences the expenditure of energy in household tasks, being less when the equipment is adjusted to a comfortable height. A paper reporting the results of previous studies of the energy expenditure in sewing and some other household tasks was presented at the annual meeting of the American Home Economics Association.

In the special calorimeter designed for investigation work on fruits, vegetables, and other foodstuffs, further tests were made with bananas to determine the gaseous exchange and heat elimination during the ripening period and to observe the effect of humidity and carbon dioxid on the ripening of the fruit. A study was also made of the shrinkage in a quarter of beef under conditions comparable with the cool-storage room in a retail market. The beef kept in the respiration calorimeter for 13 days was in the condition termed "hotel ripe" when removed, and the shrinkage was 2 per cent.

Considerable progress was made on the egg calorimeter that is being constructed in cooperation with the Bureau of Animal Industry.

The studies of the cost and conditions of living in farm homes were continued in cooperation with the Bureau of Agricultural Economics. In addition to tabulating and interpreting the results of the survey made during 1921 in Livingston County, N. Y., and preparing them for publication in bulletin form, the schedules have been revised for use in further studies in other sections of the United States. The field work on these studies has already begun in four States.

Another phase of work dealing with the economics of the home is the preparation of a new blank form for use in making time studies of household labor. By means of this form needed figures can be obtained on the cost of preparing and serving food, making clothing and household linens, care of the house, laundry work, and various other kinds of services performed in the home. Such information is of assistance to the home manager in determining which services are most essential and profitable, just as labor records have assisted the farm manager in determining which farm practices are most profitable.

A systematic search of scientific literature and other sources of information has been made for the purpose of revising and increasing the scope of the bulletin entitled "The chemical composition of American food materials," which was compiled originally in connection with the nutrition investigations carried on by the department. The list of foods has been considerably extended to include those on which data were not hitherto available and others that have come into the market since the original bulletin was published. Special efforts have been made to bring together data about fruits and vegetables, particularly tropical and subtropical kinds, that are now grown or being tested in the United States or are of importance in the Philippines and our island possessions.

At the request of the Department of Agriculture, the Bureau of Standards, cooperating with the Office of Home Economics, resumed the extended investigations on the tarnishing and detarnishing of silver, begun some years ago but discontinued during the war period. The tarnishing of silver was shown to be due to a sulphid film on the surface of which certain colors are not only characteristic but indicate the extent of the tarnish. Hydrogen sulphid gas, if pure and dry, has little effect on silver. The presence of a small amount of moisture and of sulphur dioxid greatly accelerates tarnishing, as does the presence of films on the surface of the silver, such as a soap film which remains after washing.

Three methods of detarnishing silver were studied—the electrolytic, the abrasive, and the cyanid. The electrolytic method proved to be the most desirable for household use because it is rapid and entails less waste of silver than the others. The cyanid solution, aside from its unsuitability for home use because of its poisonous nature, proved to be particularly wasteful of silver. Study of the rate of cleaning and corrosion of specimens was made to determine the relative merits of solutions used. The formation and properties of moss silver were studied. Potential differences between the various cleaning devices and the silver specimens were determined. One purpose of the work was the determination of the speed of operation and the relative loss of silver.

A considerable number of tests were made of mending china with water glass and cements of different sorts and of replacing missing parts with commercial and homemade pastes and other plastic substances. Some work on refinishing wood was also done. The purpose has been to test existing household methods and to try others which suggest themselves as being of possible use. Such surveys of methods, if rightly carried out, provide data for immediate use in practicing one of the household arts and point the way to many problems for laboratory study.

In addition to the publications already mentioned, the following reports of various lines of work carried on in this office were published during the year by the department and in professional journals: Department Bulletin 1033, "Digestibility of cod-liver, Java-almond, tea-seed, and watermelon-seed oils, deer fat, and some blended hydrogenated fats," gives the findings from two groups of studies in a series of tests of the digestibility of 63 fats and oils of animal and vegetable origin, including the important hydrogenated kinds. A paper summarizing all these investigations briefly was printed in one of the chemical journals.

Farmers' bulletins as follows were published: "Corn and its uses as food," which brings together practical suggestions for preparing and serving corn meal, hominy, and other corn products; "Good proportions in the diet," which supersedes an earlier bulletin entitled "A week's food for an average family," and discusses the problem of food selection as regards adequacy, wholesomeness, attractiveness, and cost; and "Lamb and mutton and their use in the diet," which gives information on the dietary value of these meats and attractive ways of preparing them for the table.

An earlier farmers' bulletin discussing the food value of milk and its uses in the home was thoroughly revised and submitted for publication. Two other farmers' bulletins, one on the care of food in the home and the other a revision of a department bulletin entitled "Food values: How foods meet body needs," were also submitted for publication.

A chart showing 100-calorie portions of certain foods, supplementing the food-selection and meal-planning charts published by the department, and a revised edition of Department Circular 189, "A well-planned kitchen," were submitted for publication.

That the interest of housewives and of teachers in the work of the office continues is shown by the increased volume of correspondence requesting information on home-economics topics. This direct and valuable contact with the housekeeper and her problems has grown from a few inquiries a week to such a volume that the full time of a well-trained, experienced worker is hardly sufficient to meet it.

# REPORT OF THE FEDERAL HORTICULTURAL BOARD.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FEDERAL HORTICULTURAL BOARD,
*Washington, D. C., October 1, 1923.*

SIR: I submit herewith an executive report covering the administration of the plant quarantine act for the fiscal year ended June 30, 1923.

Respectfully,

C. L. MARLATT,
*Chairman of Board.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

## INTRODUCTION.

A review is herein given of the more important activities of the Federal Horticultural Board in the enforcement of the plant quarantine act of August 20, 1912, including quarantine and other control of important pests under the administration of the board either directly or in cooperation with the Bureaus of Entomology and Plant Industry, enforcement of various foreign and domestic quarantines, and control and safeguarding of regulated products at ports of entry. A more detailed record of the work of the board is given in the Service and Regulatory Announcements published from time to time during the year. These announcements include the full text of all quarantines and regulations issued during the year, together with explanatory press and other statements.

With respect to the important control or eradication operations, this report brings the record down to October 1, 1923, to give, as far as possible, the complete results of the crop season. On the other hand, the records of control of imports normally coincide fairly well with the fiscal year, and the tabular records are on that basis.

## THE PINK BOLLWORM.

*Present status.*—The outstanding feature of the pink bollworm situation in the United States, October 1, 1923, is that no new infestations have been found during the year and that, except in the extreme western districts, no infestation whatever has been determined in any of the territory where the insect had previously been established. This indicates strongly the ultimate success of the effort to stamp out this important pest in the main part of the Cotton Belt. The situation is especially encouraging in Louisiana, where in the two large districts originally invaded no infestation has been found

for over two years. Similarly, in the Trinity Bay area in Texas, where in 1917 all or parts of seven counties were found infested, and also in the other minor areas in central and eastern Texas, the measures taken, namely, the cleaning of the fields and establishment of noncotton and regulated zones, have reduced the infestation to the point where only one infested boll was found in 1921 and that was in the Trinity Bay area, and none whatever in all areas in 1922, and in 1923.

No continued effort has been made to eradicate the pink bollworm in extreme western Texas and New Mexico for the reason that the proximity to the Mexican border would insure reinfestation after any noncotton period. The danger of infestation spreading from the western area into the Cotton Belt proper has, however, been greatly reduced by quarantine and the installation of disinfecting machines in all gins. These precautions, with the natural isolation of the areas affected, reduce the danger of spread from these areas of infestation to a degree not greater than that incident to the infestations in Mexico.

While the work of eradiction is now in a very satisfactory condition, it would be too much to expect that there will be no reoccurrences of infestation in some of the areas where eradication has been undertaken, and it is possible that new centers of infestation may be found. The control of any future outbreaks is, however, reasonably assured by what has already been accomplished. Certainly no relaxation should be permitted in the work which is under way. Intensive field scouting must be continued and funds must be available for immediate clean-up and other repressive measures if the results which have been secured are to be retained. It is interesting to note, in the matter of comparison, that in the Laguna area, the principal cotton producing district of Mexico, where the pink bollworm has now been established upward of 10 years, it is apparently still increasing in intensity of infestation and in the amount of loss occasioned. The infestation during the past season seems to have been much more severe than in the two preceding years and the present indications are that the production will be only about half the normal crop, this result being in part, however, chargeable to the depredations of the cotton-leaf worm.

*Scouting.*—With reference to the crop of 1922, a total of 7,760 man-days of scouting was performed. Seventy-one per cent of the time was spent in Texas, 16 per cent in Louisiana, and 13 per cent in other States and in Mexico. One thousand five hundred and eighty-nine fields in 219 localities, with a total area of 88,120 acres, were examined. These fields were carefully selected with reference to previous infestations or to known risk from seed or other reasons. The most useful scouting period includes the months of September to January or February, and this work, therefore, in connection with the crop of 1923, is, at this writing, in full progress.

As a part of the protection maintained as to reinfestation from Mexico, a border inspection was made in Mexico that included practically every field along the Rio Grande from a point opposite Del Rio to the mouth of the river, and no infestation was determined. This range of inspection included the San Carlos district opposite Del Rio and the fields in the Allende district about 40 miles southwest of Eagle Pass, Tex., where the pink bollworm was found

several years ago, but as noted without finding any field infestation.

*Clean-up.*—During 1922, 13,405 acres of cotton land were cleaned at a total cost of $26,156.24. These fields were at Ennis, Marilee, and Liberty, Tex., and Shreveport, La. In each case the area cleaned was immediately adjoining noncotton zones. So far there has developed very minor need for cleanup work of this kind in connection with the crop of 1923. A comparatively small area will, however, be cleaned as an additional precaution in the case of quarantined areas at Ennis and Marilee.

Since the inauguration of the work in 1917, 53,042 acres have been cleaned at a total cost to the department of $395,988.14. Undoubtedly this work has been the most important single factor in bringing about the eradication of the insect.

*Progress in disinfecting cottonseed.*—The installation of disinfecting machines at gins in regulated zones was begun in 1921 and continued in 1922–23. In 1922, 37 of these machines were in operation, treating about 35,000 tons of seed at a cost of from 10 to 25 cents per ton. These machines are installed so that the disinfection of the seed becomes automatically a part of the process of handling at the gins. Since by far the most important agency in the dissemination of the pink bollworm is cottonseed, the installation of this disinfecting system in all areas under suspicion is one of the most important protective measures which has ever been taken. It has proved possible to subject the seed under practical conditions to a temperature which will destroy the pink bollworm and not in any degree affect germination.

The disinfection of seed is not a complete local protection from the pink bollworm, as a certain amount of infestation remains in the field. Nevertheless, disinfection at the gins undoubtedly destroys the great majority of the insects present and eliminates the danger of the carriage of infestation by the agency of seed over long distances, and this has been one of the principal dangers which has confronted the department in its fight against the pink bollworm.

*Revision of regulations.*—Effective on June 1, 1923, the quarantine on account of the pink bollworm was materially revised to cover necessary changes in the quarantined areas and to simplify the administration. Under this revision the amount of strictly regulatory work. such as the issuing of permits, will be greatly reduced, and a number of men will be released for the essential work of field inspections. In the calendar year 1922, 10,701 permits were issued. The new regulations will reduce the number by more than 50 per cent but without reducing the efficiency of the protective measures.

*New legislation in New Mexico.*—A decided forward step was taken by New Mexico in passing a law (March 7, 1923) licensing gins and requiring as a condition of the issuance of the license the installation of an approved seed-disinfecting machine. In other States this is accomplished through regulations under general laws, but there is considerable advantage in having a direct statutory provision on the matter.

*Research in Mexico.*—The research work on the pink bollworm in the Laguna district, Mexico, was continued with headquarters as heretofore at Tlahualilo. One phase of this work dealt with experiments and observations on the reaction of various cotton varieties

to the pink bollworm. The indication obtained in previous work that a considerable number of larvæ can be killed by the application of poison was followed up with detailed tests in the field and laboratory. Different poisons were used and different methods of application tested. A very noticeable degree of reduction in the number of larvæ in the bolls was obtained, but many details remain to be worked out before a decision can be reached as to the practical usefulness of poisons. It is safe to say, however, that the indications for a successful outcome are at least as good as they were in the case of the cotton boll weevil as recently as eight years ago. The amount of control of the insect which can be secured through different methods of tillage and different systems of handling the water for irrigation was studied. On account of the seasonal and other variations from year to year, it is necessary to continue work of this kind for a series of years before exact knowledge is gained. Other lines of observation dealt with the distance of flight of the pink bollworm moth, the condition under which plants other than cotton are attacked, the thermal death point of larvæ, and the effect of conditions of seed storage on larvæ longevity. A bulletin dealing with the results obtained has been submitted for publication.

## MEXICAN BORDER CONTROL.

The border control to prevent the reentry of the pink bollworm from Mexico into the cotton fields of the South has been continued on the Texas-Mexican border. This service was organized primarily to safeguard the cotton industry, but the inspectors also assist in enforcing all quarantines which relate to plants and plant products, the entry of which from Mexico is prohibited or regulated.

During the fiscal year ending June 30, 1923, 23,132 freight cars were inspected on the Mexican side of the border for cottonseed, and of this number 13,719 were fumigated in houses constructed for the purpose as a condition of entry by representatives of the board. Fumigation fees amounting to $54,128 were collected and turned into the Treasury. At Del Rio, where there are no railroads entering Mexico, 23,694 vehicles crossing the border were inspected. Fifty-two of these vehicles were found to be contaminated with cottonseed and after a thorough cleaning were, as an additional precaution, fumigated, for which fees amounting to $26 were collected and turned into the Treasury.

A fire originating in the tanks of a local oil company on July 19, 1922, resulted in the total destruction of the 15-car fumigation house located at Laredo, Tex. In the absence of a fumigation house, it was necessary to fumigate the interior of all box cars and to spray all flat cars and gondolas. In view of the increase in the number of cars crossing the border at this point during the fiscal year 1922, it was deemed desirable to construct a 20-car house. This house was completed at a cost of approximately $45,000 and put into operation on May 4, 1923.

As in the past, inspectors of the Federal Horticultural Board have been cooperating with customs officials in the inspection at footbridges to prevent the entry of contraband plants and plant products. This cooperation exists at Brownsville, Laredo, Eagle Pass, Del

Rio, and El Paso, Tex., as well as on the boundary line at Nogales, Ariz. During the period under review many interceptions were made of contraband material, some of which was infested with exotic insects injurious to cultivated fruits and crops. The value of this phase of the border work is evidenced by the fact that 33,636 pieces of contraband plants and plant products were taken from passengers and pedestrians entering the States.

## EUROPEAN CORN BORER.

The domestic quarantine on account of the European corn borer was amended four times during the year to include such extensions of territory as were determined from time to time. (See record on p. 31.) These extensions have all been in connection with old districts and represent the natural and, in large part, unpreventable local spread of the pest. There have been no reports of new centers of infestation remote from the old known centers.

The corn borer quarantine and regulations have been modified as to the New England district, so that more funds could be devoted and more work could be done in western New York, northern Ohio, and some areas in Michigan immediately adjacent to Detroit, where the invasion of this pest comes closest to the great Corn Belt of the Middle West.

The inspection and certification which was formerly carried out at the point of origin of the products and applied to all marketed products, is now limited to products which are to be shipped out of the quarantined area, and this is done very largely in the Boston wholesale market. This change makes a saving of approximately two-thirds in the cost of inspection in this district—a reduction from approximately $75,000 to $25,000. It has been necessary, however, to maintain some inspection and certification at outlying points for the inspection of ornamentals and vegetables which are shipped interstate directly from the point of production—farm or nursery.

The inspection for the eastern New York district is conducted in the wholesale markets in Albany, N. Y., and is limited to the inspection and certification of sweet corn grown outside of the quarantined area but which comes into Albany for shipment interstate or otherwise to points beyond the quarantine line. The inspection in the western New York area is limited largely to the required certification of products as a condition of movement into Canada, inasmuch as there is little other movement out of the district. For the Ohio and Michigan areas inspection has been maintained in the Cleveland markets to safeguard the movement of corn beyond the quarantined area chiefly into the southern markets of Ohio. Inspectors are also stationed in Michigan at Detroit and other ports of entry from Canada within the quarantined area to prevent the entry of quarantined products from Canada which have not been certified by Canadian officials. The main highways leading out of these western quarantined areas have been under supervision and inspection to prevent sweet corn on the cob from being carried out of the quarantined area in motors or other vehicles. In addition to this work, field inspections have been conducted around all the infested areas to determine the spread of the insect for the purpose of rectifying the quarantine lines.

The inspection and quarantine work in both the eastern and western areas has been on a cooperative basis with the States concerned.

### RESTRICTIONS ON ENTRY OF BROOMCORN.

For several years the entry of foreign broomcorn has been safeguarded by requiring the steam disinfection of all such corn at ports of entry, this treatment being necessitated by the fact that in spite of such efforts as have been made on the part of foreign shippers to select and export sound material, all broomcorn coming to the United States has been more or less infested with the larvæ of the European or other corn borers. Practically all such imports have been from Europe, but broomcorn from other parts of the world has indicated a similar danger of carrying stalk borers new to the United States.

Early in February, 1923, in view of the unusually large imports of broomcorn in prospect, it seemed desirable to limit entry to the period between November 1 and March 31 of each year so that any risk from delay in fumigation would be further safeguarded by the fact that the insect would still be in a dormant winter condition.

Due to the shortage of production in the United States, the entry of broomcorn exceeded all previous records and the supply awaiting fumigation and in transit as March 31 approached was such as to make it apparent that it could not be disinfected and disposed of by that period. It became necessary, therefore, to order the removal or transfer of some of this corn from the port of New York by lighterage to Boston, where further delay in its disinfection would involve no new risk to the United States.

In view of the generally unsatisfactory situation which developed in March and April at the port of New York on account of the great quantities of broomcorn entered and the delays in its disinfection, the provision for the entry of this product was again changed, limiting entry at New York, San Francisco, and any other port where sterilization is possible, to the period between November 1 and February 28 of each year, but permitting entry throughout the year at Boston. Any broomcorn arriving at New York or other port except Boston subsequent to February 28 and prior to November 1 will be required to be immediately transferred to Boston by lighterage or other means and without being unloaded on the New York docks.

### JAPANESE BEETLE QUARANTINE.

The quarantine on account of the Japanese beetle was entirely revised, effective April 15. This revision was based on a conference held by the Federal Horticultural Board and Bureau of Entomology October 12, 1922, participated in by the official representatives of New Jersey and Pennsylvania. A new policy in control methods was agreed upon at this conference, involving what is termed the "zoning system." Under this system the city of Philadelphia and its suburbs are now included within the controlled area so as to allow free movement of locally produced farm products within the more important distribution radius from Philadelphia. In point of fact, the Japanese beetle has already extended its range to include

most of the city of Philadelphia and a considerable portion of the outlying district.

The adoption of the zoning system has made it possible with the funds provided by Congress, with the support of State funds, to carry out the control now provided for in these revised regulations. The increase in the Japanese beetle area made it impossible to carry out the old plan of inspection of all controlled products on the farm or place of origin. The zoning plan of control is capable of extension from time to time to take up further spread of the beetle. No other plan seems to be feasible which would not involve an expense beyond any probable appropriation by Congress or the States concerned.

The increase and spread of the Japanese beetle and the nature of its depredations have demonstrated that this pest is one of the most dangerous insect introductions which has ever occurred in this country. It threatens enormous future losses, particularly to fruit and forage crops. It is recognized that eradication is impossible, and that ultimately the pest is bound to spread widely in the United States. The principal means of long-distance spread of this pest is in connection with the movement of various farm and truck crops and fruits and florist and ornamental stock. Its natural spread by flight seems to be from 5 to 10 miles per year and the object of quarantine restrictions on carrying products is to restrain its spread by long jumps by such agencies until means of artificial control can be developed or until control is brought about by the introduction and establishment of natural enemies.

## GIPSY MOTH AND BROWN-TAIL MOTH QUARANTINE.

The quarantine on account of the gipsy moth and the brown-tail moth was amended effective July 1, 1923, to cover the additions or reductions of territory.

This quarantine was again amended August 21, 1923, immediately effective, to give greater security to the inspection of nursery stock moving out of the quarantine district. A considerable increase of infestation had been allowed to develop in some of the nurseries of the district, and particularly in the case of evergreens, the inspection of such stock and an attempt to remove egg masses or other stages of these pests, and especially the gipsy moth, involves a risk of overlooking infestation which can not be entirely obviated. Inasmuch as a good deal of this increased infestation was evidently due to the laxity or indifference on the part of the owners, it seemed to be desirable to further safeguard the situation by considering the plan of refusing to certify stock for movement out of the invaded districts from nurseries which are palpably infested with these pests. For the discussion of this proposition a conference was held with nurserymen and State and other authorities and persons in interest at the State House, Boston, Mass., August 17, 1923. As a result of the discussion the nurserymen themselves heartily agreed to the desirability of a regulation of this kind, realizing that their own status with their clients would thereby be greatly improved. To carry out this idea regulation 7 of Quarantine 45 was amended to provide that whenever any nursery in the gipsy moth or brown-tail moth area is reported by a State inspector to be appreciably infested with

either the gipsy moth or the brown-tail moth, or whenever such infestation is determined by a Federal inspector on his examination of shipments from such nursery, further certification for interstate movement from that nursery will be refused until after the close of the next gipsy moth egg-laying season, unless and until such nursery has been inspected and certified by the State to be apparently clean.

As hitherto, no quarantine has been declared to cover the determined areas of infestation in New Jersey and New York resulting from the central colony at Somerville, N. J., in appreciation of the fact that the quarantine and control operations enforced as they are by these two States in cooperation with and largely under the direction of the experts of the Bureau of Entomology of the department have been apparently fully adequate.

## DATE-SCALE ERADICATION.

In connection with the Parlatoria date-scale eradication work of 1923, it has been possible for the first time to bring all the date plantings known to be infested under adequate treatment, including the thorough pruning and burning of all infested trees. A close follow-up inspection is now being maintained and must be continued for each infested orchard for two or three years after the last infested tree has been found and cleaned up to make sure that this pest is completely eradicated.

By arrangement between the Federal Horticultural Board and the Bureau of Plant Industry, date palms imported from abroad are being established in nurseries to remain under the control of the department for from 15 to 20 years. The offshoots produced by these imported palms, however, will be sold to the public as soon as they are considered free from Parlatoria. This policy has resulted in the establishment of some six quarantined nurseries in California and Arizona in which are planted the 10,000 date offshoots imported from Algeria and Egypt in 1920, 1921, and 1922. These nurseries will be cleaned up as thoroughly as possible and the offshoots removed from them and disposed of for planting in date orchards. The latter will be kept under inspection for two or three years to determine their complete freedom from pests.

As has been emphasized in previous reports, it is the belief of the horticultural experts in charge of the development of date culture in this country that this industry can not hope to become and continue a profitable one unless the Parlatoria scale is eradicated. It is their belief, however, that if the present campaign of eradication is continued for a few years its ultimate complete success is assured.

The second of the two scales which seriously affect date plantings in the United States and date cultures of the Old World is the so-called Phoenicococcus, or red date scale, which up to the present time has been considered to be too deeply seated beneath the overlapping bases of the leaves of the plant to make its eradication possible, and control measures only have been used against it. The Phoenicococcus scale is, however, much easier of practical orchard control than is the Parlatoria scale and date culture can be carried on without serious difficulty even if the former is present. The possibility, however, of eradicating the Phoenicococcus scale

has been indicated by the experience of the last year or two, and it is now believed that at least important districts can be established in this country which will be free from both the Phoenicococcus and the Parlatoria scales. Such scale-free districts would offer important future possibilities in the way of foreign trade in the exportation of date offshoots as, for example, in the case of the possible date culture which may later develop in Australia and South Africa. At present these countries are unable to obtain scale-free offshoots on account of strict quarantine laws enforced by them which exclude all date offshoots from the date countries of the Old World.

### REVISION OF HAWAIIAN FRUIT-FLY QUARANTINE.

The quarantine of Hawaii on account of the Mediterranean fruit fly and the melon fly was revised, effective December 1, 1922, to make more explicit the inspection requirement of vessels, cargo, etc., at ports of arrival in the United States. The new restrictions make specific provision for the boarding and inspection of vessels at quarantine by department inspectors. If such vessels are found to be fouled with fruit-fly larvæ, pupæ, etc., or to contain any contraband fruits and vegetables, such material must be destroyed and the vessel must be disinfected before leaving the quarantine area. The new regulations provide specifically also for the inspection of baggage and cargo on the dock, making possible greater efficiency and safety.

### THE CAMPHOR SCALE.

The placing of a Federal quarantine on Louisiana and Alabama to prevent the spread of the so-called camphor scale, a newly discovered crop insect pest, was considered at a public hearing held in Washington, November 20, 1922. As a result of this hearing the board decided not to recommend a Federal quarantine at that time on account of this scale pest, for the reasons indicated below. Representations were also made by officials of the invaded States that the safeguards which these States were maintaining or which they proposed to maintain in the future would control the distribution of the pest as efficiently as could probably be accomplished under Federal quarantine.

The information brought out at this hearing as to the spread of this pest was believed to be not sufficiently adequate and dependable to enable the establishment of a Federal quarantine. Furthermore, prior to the discovery of this scale, shipments of nursery stock and plants had been made widely throughout the United States from New Orleans nurseries, furnishing abundant opportunity for the dissemination of this scale pest. Further and perhaps even broader opportunity for similar wide distribution is indicated by the discovery, subsequent to the hearing, of the long establishment of this pest in Texas, discussed below.

The need of Federal action is much lessened also by the fact that the two States most concerned in the menace of this scale to the citrus culture—Florida and California—are now enforcing quarantines against citrus and other carrying plants from the invaded States.

The Department of Agriculture, through the Bureau of Entomology, however, proposes to cooperate with the States where the

pest is now more or less established for the purpose of aiding these States in the local control to prevent spread, particularly with respect to the inspection and disinfection of commercial or other shipments of fruit or nursery stock originating in the invaded areas.

The present status in Mississippi, as brought out at the hearing on November 20, would seem to indicate that the few points of invasion have been completely cleaned up and that this scale is probably not now present in that State. A State quarantine is being enforced to prevent further entry of the scale.

In Louisiana control work has been largely limited to the city and immediate vicinity of New Orleans, which is the district known to be principally invaded. Control of shipments out of this district is being enforced under State authority and the State and city are spending a good deal of money, in cooperation with the Bureau of Entomology, in local clean-up and repression. The State promises to extend control to all points known to be invaded outside of the New Orleans district.

The Alabama authorities report that steps have already been taken to provide for control measures and have given assurances that such control will be promptly instituted. The invaded district is a very small one in that State, limited so far as now known to the citrus development (Satsuma oranges) in the Grand Bay district near Mobile. The control of this pest, therefore, as to that district is of vital importance to other portions of Alabama as well as in relation to interstate shipments of fruit or plants originating in the invaded district.

Reference has already been made to the existence for a considerable period of the camphor scale in Texas. In May, 1923, an inspector of the Bureau of Entomology traced an infestation in the Grand Bay district, Alabama, to Satsuma orange and fig trees obtained some 12 years before from a Japanese nursery at Alvin, Tex. An inspection of this nursery made shortly afterwards showed that the property—some 300 acres—now abandoned as a nursery but still containing some 10,000 camphor trees, was scatteringly infested throughout with the camphor scale. This nursery was started in 1907, importing its citrus stock directly from Japan, indicating clearly the source of origin of the scale. In fact, the importations for this nursery may have been the original and chief means of introducing this scale pest into the United States. A good deal of the stock of this nursery, on or prior to its abandonment in 1919, was removed to another Japanese nursery at Genoa, Tex., and other material went to a nursery at Beaumont, and still other material was variously distributed to Houston and elsewhere and to States as remote from the center as Colorado and Massachusetts. During the 12-year period of the operation of the nursery at Alvin, it was the source of distribution of orange, fig, camphor, and other trees not only widely in Texas, but in other States. The State of Texas has taken no steps to clean this property, now used as a stock ranch, nor to make any inspections to determine the possible establishment of this pest elsewhere in the State—representing that it has no available men or funds for such work. A survey is now being conducted by the Bureau of Entomology of this department under the camphor scale appropriation to determine in a general

way the spread of this scale, in Texas and other Southern States, through the agency of the Alvin, New Orleans, and other nurseries.

The camphor scale is a new pest to the United States. It apparently gained entry and establishment just prior to the passage of the plant quarantine act, and therefore before there was any Federal authority to safeguard the entry of the plants responsible for its introduction. The origin of this scale in Alabama is apparently traceable to very large importations of trifoliate oranges direct from Japan in 1911. The infestation at New Orleans may have resulted from some distribution of a portion of this importation, if not from some independent importation of plants from Japan about the same time. It took nearly 10 years for this scale to develop in sufficient abundance to attract notice, but some three years ago its injury to camphor trees in New Orleans became serious, and the scale was found to be widely disseminated within the city on a long list of host plants. The city and State immediately undertook an effort to control and, if possible, to eradicate it, and have already spent upward of $30,000 in such work.

The determination of infestation in Alabama, near Mobile, was made in 1921 in orchards of Satsuma oranges grafted on the imported trifoliate stock. The work of this scale in these orchards indicates the serious menace which it presents to the citrus cultures in this country, in addition to its previously known importance as attacking camphor and many other ornamental plants as well as various deciduous fruits, such as olive, persimmon, fig, plum, and pecan.

## POTATO WART.

The known distribution of the potato wart in Pennsylvania, West Virginia, and Maryland remains unchanged. No further survey has been conducted, but dependence has been placed on collaborators in the plant-disease survey of the Bureau of Plant Industry and on county agents and other agricultural correspondents to report any new points of infection.

Two modifications of the Pennsylvania quarantine have been put into effect, as follows:

An amendment to the State quarantine law makes it possible for quarantine inspectors to confiscate and destroy any potato plants of other than approved immune varieties which are found in the quarantined areas. This has enabled the inspectors to begin their work in June, as soon as varietal characteristics are evident, and to remove susceptible plants before infection occurs. Previously it has been necessary to prove that the plant is infected before it could be removed, and usually this could be done only after the infection had progressed to such a stage that a new crop of resting spores of the parasite had been released into the soil, thus prolonging the latent existence of the disease.

Due to widespread dissatisfaction of the commercial potato growers in the agricultural districts surrounding the Freeland infested area with the immune varieties which they were required to grow, particularly the Green Mountain variety on account of its susceptibility to common scab, the requirement of planting only immune varieties in this "safety zone" was temporarily withdrawn. The prevalence of scab in the Green Mountain variety was in part due

to the use of lime in their potato fields by these growers, and in part to climatic conditions specially favorable to scab. In respect to yield and market quality this variety continued to be very satisfactory. This difficulty with potato scab serves to illustrate the fact that it is not yet possible to safeguard all our potato-growing sections against the introduction and spread of wart by the use of immune varieties without placing a severe burden on the growers in certain sections for which well-adapted immune sorts have not been determined. The release of the "safety zone" from the requirement of immune planting has resulted in an extensive return to the growing of the highly wart-susceptible Russet-Rural variety. Special measures are being taken by the State department of agriculture to insure thorough inspection at digging time of all such plantings. This experiment, if it may be so called, should at least give additional and positive information regarding the distribution of the disease, if any, beyond the old determined areas of infestation.

In Maryland the furnishing of an approved immune variety of potato for planting in infested gardens was undertaken by the State, with the result that all the known infested gardens in which potatoes were grown this year were planted to a pure stock of Irish Cobblers.

As a result of the experience that has been acquired and the studies that have been made on potato wart since its discovery in Pennsylvania five years ago, it is the belief of the specialists that American potato culture is not seriously threatened by the disease. It is their belief that if the growth of immune varieties can be enforced for a period of years, as now seems possible under State quarantines, there is reasonable hope of entirely eliminating potato wart from this country within no great period of years and at no great cost either to the States concerned or to the growers in areas under quarantine. It is still highly important that accurate information as to the distribution of the disease, particularly as regards its appearance in new areas, be secured, and the strict use of only immune potatoes in all infested gardens must be enforced.

Investigational work complete and published, or nearing completion, affords a sound basis for determining the future attitude which the Department of Agriculture may take toward this disease. The conditions of infection and the factors operative in dispersal and elimination of the parasite have been worked out to reasonable completeness. The application of soil sterilization to the problem of wart extermination has been investigated and new information has been secured regarding the use of heat and chemicals for this purpose. There remain several scientific questions of importance and great interest which will receive further attention in the Bureau of Plant Industry.

## WHITE PINE BLISTER RUST QUARANTINES.

Following up the quarantine of certain counties of Washington lying west of the summit of the Cascade Mountains, promulgated March 15, 1922, on account of the discovery by agents of the Department of Agriculture of several blister-rust infestations, principally on black currants, in the Puget Sound region of Washington, it became necessary in March of this year to extend this quarantine to cover the entire State. This action followed an amendment to the

quarantine promulgated by the State permitting the intrastate movement from licensed and inspected nurseries of all currants (except cultivated black currants) and gooseberries from the territory heretofore under quarantine west of the Cascade Mountains. The need for maintaining as thoroughgoing quarantine protection as possible in this region is to prevent the spread of the disease to the very valuable commercial stand of western white and sugar pine forests of the Rocky Mountain and Pacific coast regions.

The board is now enforcing two domestic quarantines on the subject of the white pine blister rust. These are Nos. 26 and 54, the latter covering Washington, as just discussed. Quarantine No. 26 as now amended prohibits the interstate movement of five-leafed pines, currant, and gooseberry plants from all of the States east of and including the States of Minnesota, Iowa, Missouri, Arkansas, and Louisiana to points west of these States. Within this large quarantined area two supplemental quarantine districts have been established, the first covering all of the New England States and New York, for the protection of the States within the larger quarantined area lying west of this group in which the pine blister rust is either not established or has very limited foothold, and the second to protect New York from the New England States on account of the fact that New York is making a thoroughgoing effort to eradicate this disease within her boundaries.

The enforcement of these quarantines is carried out by inspectors working under the direction of the Bureau of Plant Industry, in cooperation with the board, and with the Post Office Department, State officials, common carriers, and the nurserymen concerned.

## BLACK STEM RUST OF WHEAT.

In connection with the campaign for the eradication of the common barberry for the purpose of controlling epidemics of black stem rust on wheat, Quarantine No. 38 was promulgated, effective May 1, 1919, prohibiting the shipment of the common barberry from any State in which black stem rust occurred into any one of the 13 States comprising the eradication area, namely, Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. During the past year there have been but very few records of infractions of this quarantine, and, in general, the nurserymen have cooperated in making this quarantine effective. It should be especially noted that the campaign is directed solely toward the eradication of the common barberry and that the Japanese barberry is harmless and its use to supplant the common barberry as an ornamental is encouraged.

From the beginning of the campaign to June 30, 1923, almost all cities, towns, and villages in the 13 States have been surveyed. The original survey was completed in Wyoming, and but few counties remain to be covered in Colorado and Montana. The survey in the other 10 States progressed rapidly and an area equivalent to 484 counties was covered. From time to time resurveys are made of each property on which barberries have been found, and properties in the vicinity of large bushes, either cultivated or escaped, which are old enough to bear seeds, have been designated for especially careful resurvey the next season.

## PADDY RICE QUARANTINE.

The advisability of prohibiting or restricting the entry of seed or paddy rice from all foreign countries and localities not already covered by quarantine was considered at a public hearing held in Washington June 11, 1923. The reason for this consideration is the danger of entry of injurious plant diseases and insect pests with unhulled or paddy rice. The principal rice-producing or exporting countries of the world had already been covered in Quarantine No. 39 on account of flag smut and take-all diseases, but occasional shipments of paddy rice were being offered for entry into the United States from China and other countries not then covered by quarantine, and it seemed desirable therefore to consider the extension of the quarantine referred to to control the entry of paddy rice from all foreign countries. It was brought out at the hearing that the rice industry of Mexico is much of it of recent origin; that the rice cultures of Mexico are apparently free from the diseases which are known to occur in other foreign countries; and that there is a considerable demand for Mexican paddy or seed rice for planting in the United States. As a result of this showing the quarantine as subsequently promulgated July 17, 1923, makes provision for the entry of seed or paddy rice from Mexico under adequate safeguards.

It may be noted that the restrictions which are now being enforced on the entry of seed rice leave open to free entry into the United States foreign hulled rice for food purposes.

## NURSERY STOCK, PLANT, AND SEED QUARANTINE.

### BULB CONFERENCE.

Supplementary to the plant quarantine conference of May 15, 1922, which was called to consider the various provisions of Quarantine 37, a conference was held on October 30 of the same year to consider the subject of bulb importations. As a result of this conference regulation 3 of Quarantine 37 was amended to permit the unlimited entry for a period not to exceed three years from January 1, 1923, of the following additional bulbs:

Chionodoxa (glory-of-the-snow).
Galanthus (snowdrop).
Scilla (squill).
*Fritillaria imperialis* (crown imperial).
*Fritillaria meleagris* (guineahen-flower).
Muscari (grape hyacinth).
Ixia.
Eranthis (winter aconite).

The termination at the end of a period not to exceed three years of the unlimited entry of narcissus bulbs was also authorized.

### REVISION OF FREEDOM FROM SOIL REQUIREMENT.

An informal conference between the Federal Horticultural Board and the advisory committee of the American Association of Nurserymen was held on October 3, 1922. It was represented by the conferees that the washing of the roots, particularly of certain classes of plants, as performed abroad was a source of injury to importa-

tions and the cause of considerable losses. Many instances of such injury were presented. On the other hand, it was brought out that this injury was often due to careless methods of washing and also to harmful methods of packing and shipping. It was shown that such washing had been done by some exporters without any injury whatever to classes of plants which were supposed to be most susceptible to such injury. Nevertheless, the importers were convinced that it would be more practicable to permit the removal of earth by shaking or other means where such removal could be thus effectively accomplished. As a result of this discussion the board agreed to modify that portion of regulation 7 of Quarantine 37 which relates to freedom from sand, soil, and earth as follows:

All nursery stock and other plants and seeds offered for import must be free from sand, soil, or earth, and all plant roots, rhizomes, tubers, etc., must be freed by washing or other means from such sand, soil, or earth, and must be so certified by the duly authorized inspector of the country of origin.

#### PERSONAL LIABILITY AGREEMENT REPLACES BOND.

At a conference held with a committee representing the orchid collectors and growers, the one important suggestion made by the chairman of this committee was that a liability agreement would probably serve the purpose of the bond which has hitherto been required in connection with all permits issued under regulation 14 of Quarantine 37. This suggestion was taken up with the Solicitor of the department and the board was advised that a properly worded liability agreement would give essentially the same protection which the bond was designed to afford. The liability agreement was accordingly drafted by the solicitor and has replaced the bond in connection with special permits. The liability agreement is a personal agreement, duly witnessed, and eliminates the expense formerly connected with the bonding system. (For record of importations of nursery stock, plants, and seeds under this quarantine, see pp. 22–25 and Tables 1–6.)

### COTTON AND COTTON PRODUCTS QUARANTINES.

On February 24, 1923, the rules and regulations governing the importation of cotton into the United States were revised. Under that revision added safeguards were placed on the disinfection of imported cotton and all restrictions on its subsequent distribution and use were lifted. Automatically all licenses previously issued for the handling and use of foreign cotton were canceled. This releases from all restrictions as to the use of foreign cotton hundreds of spinning and other cotton mills and other establishments.

In response to numerous requests from cotton importers, the board requested the Post Office Department to open the mails for the importation of cotton and cotton waste samples when sent by parcel post addressed to the United States Department of Agriculture, Federal Horticultural Board, either at Washington, D. C., or Ferry Building, San Francisco, Calif., with the name and address of the ultimate consignee indicated in the lower left-hand corner. This request was complied with in a Post Office order under date of November 18, 1922. As a result of this order, 6,064 mail packages were received for inspection, disinfection, and redistribution in Washington, and 100 packages at the board's office in San Francisco.

In addition to these mail entries, 336 packages of cotton and cotton waste samples were received by freight and express.

The restrictions on the entry of cottonseed, seed cotton, and cottonseed products continue unchanged.

In March a disinfection plant was put into operation at Portland, Oreg. This permitted the opening of that port for cotton and cotton waste requiring disinfection. Provision was also made for the entry of waste not requiring disinfection at Norfolk, Charleston, Savannah, Galveston, St. Albans, Buffalo, Rouses Point, and Portland, Me.

Cotton lint has been under restriction since 1915—eight years. The total number of bales entered this fiscal year is 481,396, an increase over last year's importation of more than 95,000 bales. This is the second largest yearly importation of cotton lint on record. For comparative purposes there is listed below the importations for the past eight years in the order of the quantities imported:

| Year: | Bales. | Year: | Bales. |
|---|---|---|---|
| 1919–20 | 595, 765 | 1920–21 | 221, 303 |
| 1922–23 | 481, 396 | 1916–17 | 216, 337 |
| 1921–22 | 386, 303 | 1917–18 | 195, 723 |
| 1915–16 | 316, 260 | 1918–19 | 179, 537 |

This year's importations of cotton, cotton waste, and bagging total 825,438 bales and make the largest yearly combined entry of these commodities since they were placed under restriction. They exceed the next largest year by nearly 50,000 bales. A tremendous increase over last year's importations is shown in each commodity.

Disinfection as a condition of entry is required as to the bulk of these products and entry under disinfection is, therefore, restricted to the ports of Boston, New York, San Francisco, Seattle, and Portland, Oreg., where disinfection plants under private ownership and management, but under the supervision of Federal inspectors, are located. Provision is made under the quarantine for the entry of certain cotton and cotton waste and bagging without disinfection where, from the origin, condition, or treatment of the material, or its immediate use in manufacture, such entry can be authorized without risk of being the means of introducing cotton pests. The provisions for such entry without disinfection are fully indicated in the cotton regulations. (For tables indicating, respectively, the importations of cotton, cotton waste, bagging and cottonseed, seed cotton, and cottonseed products, see pp. 26, 27.)

## FRUIT AND VEGETABLE QUARANTINE.

As a step toward keeping certain injurious fruit and melon flies out of the United States, a quarantine has been placed on all fruits and vegetables offered for import except from Canada, effective on and after November 1, 1923. This action was taken following a public hearing held December 19, 1922, at the department.

Bananas, pineapples, lemons, sour limes, and grapes of the European or Vinifera type, are permitted unlimited entry from any foreign country under this quarantine, the experts of the department believing that these fruits are reasonably free from risk. No restrictions are placed on the entry of fruits and vegetables from Canada and exceptions are made for the entry of certain fruits and vege-

tables from Mexico, Central America, the West Indies, and certain other countries. It may be noted that the fruits which enter most largely into our imports, such as bananas, lemons, grapes, etc., are open to unlimited entry. Naturally, the quarantine bears most strictly on those tropical and subtropical countries in which fruit flies are known to be most thoroughly established and the fruits and vegetables from which would therefore have a peculiar risk to this country.

That the danger of entry of important fruit fly and other pests in connection with imports of fruits and vegetables is a very real one is clearly indicated by the many interceptions of infested fruits and vegetables which have been made at various ports of entry, both by Federal and State inspectors. Many of these interceptions have been in connection with fruits brought in by passengers or by ships' crews or as a part of ships' stores, but others have been in connection with commercial shipments. Except as to the ports of California and Florida, and in very recent years New Orleans, no thoroughgoing inspection has been maintained of fruit and vegetable entries. That this country has not become invaded by fruit flies is therefore more a matter of good fortune than otherwise.

The danger is, furthermore, a rapidly growing one with the increase of world commerce and especially with the shortening of time between countries by the building of speedier ships. As an example, it is now possible to send fairly perishable fruit, such as peaches, apricots, melons, etc., from South Africa to New York and to have such fruit cross the continent to San Francisco. A portion of a shipment of nectarines so routed from South Africa was intercepted in California and found infested with fruit-fly larvæ. It is known also that various foreign countries invaded with fruit flies are making preparations to increase their fruit and vegetable exports to the United States, and some of the shipments which have already reached us from such countries, as just noted, have proved to be infested with fruit flies. The risk which will follow the more frequent and larger shipments which are in prospect is evident, and the necessity for taking prompt measures to protect the American fruit cultures from these pests would seem to require no argument.

Perhaps the most destructive of all the pests of fruits and vegetables are the various fruit flies which have gained foothold more or less widely throughout the tropical and subtropical regions of the world other than in the United States. In various countries these pests have caused tremendous losses to nearly all classes of fruits and vegetables, often preventing the further profitable production of such crops. While they are particularly disastrous in subtropical and tropical countries, their range as determined by temperature would include the citrus areas of the United States and probably extend far northward into the peach, prune, apple, and other deciduous fruit-producing areas.

## EXPLORATION AND RESEARCH WORK.

During the year the board has conducted, in cooperation with the appropriate bureaus of the department, important research work, notably with respect to the pink bollworm of cotton, potato-wart disease, and the date scale.

The life history and general research study of the pink bollworm which has been in progress for several years in the Laguna, Mexico, is reported in connection with the discussion of the pink bollworm on pages 3, 4. The research work on the potato wart is discussed under the heading "The potato wart," on pages 11, 12.

The needs for information as a basis for quarantine regulations have necessitated important surveys or exploration work in Mexico, having relation to the pink bollworm and other enemies of cotton, to fruit-fly enemies of various Mexican fruits, and to stalk borers and other insect enemies of broomcorn. A brief review of this research and exploration work follows.

*Fruit flies in Mexico.*—To determine the present status in Mexico of various fruit flies, Dr. William M. Mann, tropical insect expert of the Bureau of Entomology, made for the board during April and May a thorough field survey of fruit-fly conditions in Mexico, including surveys of the western tier of States—Lower California, Sonora, Sinaloa, Territory of Tepic—following with central and southern Mexico as far south as the Isthmus of Tehuantepec, and returning along the eastern coast, including the districts of Vera Cruz, Tampico, and northward. At the season of the year during which the western tier of States was explored no evidence was found of the presence of the Mediterranean, Mexican, or other fruit flies as far south as Tepic. This may, however, have been due to the fact that this portion of the survey was made in January and February. In the next State to the south, Jalisco, Mexican fruit fly was found in regions favorable to the insect, sparingly during March and April, and again later in May. Throughout central Mexico, south of Mexico City, and in eastern Mexico, fruit-fly infestation seemed to be fairly general and often severe. On the east coast the fruit fly has been reported as far north as Monterey. Doctor Mann was accompanied over much of his trip by officials of the Mexican department of agriculture and occasionally by fruit growers and others in interest. The Mediterranean fruit fly was not determined as occurring in any of the regions visited. No important pests were found attacking tomatoes, which are grown largely for export to the United States, and useful data were obtained with respect to the general fruit and vegetable productions of Mexico.

In general the fruit-fly situation in Mexico does not seem to warrant any reconsideration at this time of the existing quarantine restrictions as to certain Mexican fruits. To more fully determine the fruit-fly status of the west coast of Mexico, Doctor Mann was commissioned to make a second trip in October and November, and this work is now in progress.

*Cotton insects.*—H. C. Millender, of the board's technical staff, accompanied Doctor Mann for a part of the time, covering the west coast district and central Mexico, for the purpose of determining the status of the pink bollworm, cotton boll weevil, and other cotton pests along the west coast and elsewhere in Mexico other than in the known areas of infestation in the Laguna and other points in northern Mexico. The presence of the boll weevil was determined at Hermosillo (Sonora); Los Mochis, Culiacan, and Villa Union (Sinaloa); Tuxpan and Tepic (Nayarit); and Cocula (Jalisco). Study by experts failed to determine any of the material collected as belonging to the related Thurberia weevil.

The presence of the pink bollworm was not determined in any of the States listed above. The production of cotton on the west coast has not been important hitherto, but in some of the States visited the production is increasing and there seems to be a likelihood of very considerable future development.

*Mexican broomcorn.*—Requests for the direct entry without disinfection of Mexican broomcorn grown in the vicinity of Xicotencatl, on the east coast of Mexico, made it desirable to get accurate information as to the possible risks from such broomcorn of being the means of carriage of any pests new to the United States. An exploration of this district in May developed the fact that the broomcorn was more or less infested by a stalk borer apparently new to the United States. In view of the experience with the European corn borer and the fact that such borers attack a large variety of plants and, therefore, with bulk movement, would have opportunity to be introduced and established almost anywhere, it was determined that the existing regulations under the corn borer quarantine could not be modified with safety as to Mexico.

Under the European corn borer quarantine, No. 41, the entry of foreign broomcorn is restricted to certain ports of entry, now New York, Boston, and San Francisco, and under the further requirement of steam sterilization. Mexican broomcorn can therefore be entered through the ports indicated, but must reach these ports by water route.

It may be noted that there are at least three corn borers which are known to occur abundantly in Mexico, and at least one of these, *Diatraea lineolata* Walk., is apparently quite possible of becoming a serious corn pest, perhaps widely in the United States. The larvæ collected in the broomcorn at Xicotencatl seem to come closest to this species.

## QUARANTINE INSPECTION SERVICE.

This service includes (1) inspection and, if necessary, the disinfection as a condition of entry of restricted plants and plant products arriving at various ports, and examination, in cooperation with customs officials, of passengers' baggage, crews' quarters, ships' stores and cargoes, to determine their freedom from contraband material; (2) inspection, in cooperation with the customs and postal officials, of foreign parcel-post packages for contraband material; (3) inspection in the District of Columbia; (4) inspection of plant introduction gardens; and (5) Mexican border inspection (see discussion of this last under pink bollworm, pp. 4, 5).

*Port inspection.*—Owing to the large number of foreign vessels arriving at Galveston and the possibility of contraband material on these vessels, an inspector of the board was stationed at that port in February to assist and collaborate with the customs service in the enforcement of plant quarantines. Inspectors of the board are now stationed at nine of the principal ports of entry, namely, Boston, New York, Philadelphia, Baltimore, San Francisco, New Orleans, Portland, (Oreg.) Seattle, and Galveston. This service is further supplemented by collaborators, either State or Federal, stationed at 16 ports of entry in Virginia, Florida, Mississippi, and California.

In addition to the inspection of restricted plants and plant products, the inspectors of the board have supervised the fumigation of

all cotton and the sterilization of all broomcorn which has arrived at the various ports of entry.

The examination of ships in cooperation with customs officials for contraband material which may be brought either as cargo, ships' stores, crews' effects, or passengers' baggage, constitutes an important part of the work of this service. The results of the past two years' work have forcibly demonstrated the need and importance of this work. During the year, 8,282 foreign vessels were boarded and examined as follows: Baltimore, 988; Boston, 993; New Orleans, 2,211; New York, 1,600; Philadelphia, 1,551; Portland, 273; Seattle, 389; Galveston, 277 (4 months). Contraband material was found on 3,577 of the vessels boarded.

*Parcel-post inspection.*—As a result of the examination of foreign parcel post packages in cooperation with the customs and postal officials, a number of interceptions of living insects and contraband plant material were made. Many of the insects intercepted are not known to be established in the United States. In view of the large number of parcel-post packages constantly arriving, the possibilities of introducing injurious pests are ever present; and to prevent such an occurrence, the inspectors of the board are making every effort to cooperate with the officials previously referred to.

*District of Columbia inspection.*—The inspection work in the District of Columbia includes (1) the inspection of all plants and plant products introduced or distributed by the Department of Agriculture, the Botanical Garden, and the propagating garden of the War Department; (2) the inspection of commercial plant shipments entering and leaving the District of Columbia; (3) the inspection of all plants introduced under special permit in accordance with regulation 14, Quarantine 37; mail shipments in accordance with the order of March 14, 1922, relative to regulation 3, and plants introduced under contiguous permit, regulation 15, of Quarantine 37; (4) the fumigation and disinfection of all material requiring such treatment, including cotton samples. (See also p. 15.)

During the year 15,079 lots of plant material were carefully inspected for insects and plant diseases at the inspection house. Of this number, 5,398 were fumigated. In addition, 6,064 mail shipments of cotton samples were fumigated in accordance with the procedure outlined in H. B. 159, issued November 24, 1922. Many shipments of domestic grown nursery stock arrived in the District of Columbia by freight, express, and truck, and 2,660 mail shipments of plants were inspected at the post office before delivery.

*Inspection of plant introduction gardens.*—Continuing the practice which has been in vogue for a number of years, inspectors of the board have conducted the inspection of the various plant introduction gardens maintained by the Department of Agriculture at Bell, Md., Miami and Brooksville, Fla., Savannah, Ga., Chico, Calif., and the field station of the office of dry land agriculture at Mandan, N. Dak.

*Pest interceptions.*—As a result of the examinations made by the inspectors and collaborators of this service, 482 recognized species and 204 insects, which could be placed generically only, were collected on imported plants and plant products. In many instances a given

species was collected on a wide range of hosts arriving from a number of countries. Numerous insects injurious to plants and plant products were taken, many of which are not known to occur in the United States. Recognized fruit pests, such as the Mexican fruit fly in oranges and mangoes from Mexico, and sapodillas from Nicaragua; the Mediterranean fruit fly in peppers, guavas, coffee berries, avocados, rose apples, etc., from Hawaii, in loquats from Bermuda, and in apples from Algeria; and the West Indian fruit fly in Cuban plums and mangoes from Cuba and in guavas from Jamaica, were taken in ships' stores, crews' quarters, and passengers' baggage. Avocados from the interior of Mexico were found on six occasions to be infested with the avocado weevil. An unrecognized weevil (*Conotrachelus* sp.) was taken in avocados intercepted at the footbridge at Eagle Pass.

Larvæ of the pink bollworm were intercepted in cottonseed arriving from Brazil, Egypt, Dominican Republic, England, Mexico, and Porto Rico. Inspectors of the board located at Philadelphia discovered that commercial shipments of cork arriving from France occasionally bore egg masses of the gipsy moth. Brown-tail nests were on three occasions intercepted on plants from the same country. The lesser bulb fly, which has been reported on several occasions to be a serious onion pest in Europe, was collected in 27 shipments of narcissi from Holland and one from France. In one instance a single bulb was found to contain 77 living larvæ. The narcissus fly was also taken in bulbs arriving from England, France, and Holland. The snag boring emphytus, which has been reported to attack raspberries in Europe, was collected on rose stocks as follows: England, 35; France, 8; Holland, 7; Ireland, 7. The European earwig, which has been introduced into this country within recent years and is now causing considerable alarm in the Pacific Northwest, accompanied iris rhizomes from France and bulbs and delphiniums from Holland. The West Indian sweet potato weevil was intercepted on a number of occasions in yams and sweet potatoes in the possession of passengers arriving from Jamaica, Barbados, Brazil, and Porto Rico.

Many other interceptions of importance could be named. A full list of the insects intercepted on foreign plants and plant products is published annually in the Letters of Information of this board, which are available for distribution.

*Better inspection facilities needed in Washington.*—Quarantine 37, as now administered, involves the handling and inspection in Washington of a vast quantity of plant material imported for introduction and propagation purposes by commercial growers and propagators throughout the United States. It also involves the inspection of all foreign and domestic seeds and plants which are distributed by the Department of Agriculture, as well as all commercial shipments of plants that come into the District of Columbia for local purposes or which are exported from the District in interstate traffic. Much of this material must be fumigated or disinfected. It involves, further, the receipt and examination of all foreign cotton samples.

Much of this plant and other material which is thus received by this office must be disinfected as well as inspected, and must be again sent out to the ultimate consignees. Some of the material is also grown under quarantine either for the purpose of determining freedom from pests or for experimental purposes in relation to disinfection or pest control. This work has involved during the fiscal year the handling, inspection, disinfection, and reshipment of upward of 20,000 different parcels and shipments, varying in quantity from small packages to carload lots. The protective value of this work in the exclusion of plant pests has been indicated elsewhere in this report (p. 20).

The inadequacy of the inspection and holding quarters on the grounds of the department available for this important work very greatly handicaps the men engaged in it and makes it very difficult to properly handle and examine the imported and other material. The available greenhouse facilities are also entirely inadequate to care for such of this material as it is necessary to hold in quarantine or for any experimental work.

## RECORD OF IMPORTS OF RESTRICTED PLANTS AND PLANT PRODUCTS.

Under various foreign quarantines, the entry of certain plants and plant products is restricted and made subject to inspection, and, if necessary, disinfection as a condition of entry for the purpose of excluding various plant diseases and insect pests. These restricted plants and plant products include nursery stock, plants, and seeds for propagation, potatoes from various countries, various fruits, vegetables, and grains, broomcorn, and cotton, cotton waste, cotton wrappings, and cottonseed products. The records of the importations of the more important of these articles are indicated in the following discussion and tables.

### IMPORTATIONS OF NURSERY STOCK, PLANTS, AND SEEDS.

It should be noted that under regulation 2 of Quarantine 37, field, vegetable, and flower seeds, as well as all fruits, vegetables, cereals, and other plant products imported for medicinal, food, or manufacturing purposes, are free from all restrictions, even the taking out of a permit, and hence no record of the importations of these classes of seeds and plant products has hitherto been collected by the board. Hereafter, however, under the fruit and vegetable quarantine (No. 56), permits will be required for the importation of all fruits and vegetables, and an exact record of their importation will be kept.

Under regulation 3 of Quarantine 37, certain bulbs, fruit and rose stocks, and seeds are open to unlimited importation under continuing permits, over 5,700 of which have already been issued. The three tables following give a record of the importations under this regulation during the fiscal year 1923, of (1) fruit, rose, and nut stocks, (2) bulbs, and (3) seeds of woody plants.

TABLE 1.—*Importation of fruit, rose, and nut stocks.*

[Figures indicate number of plants.]

| Kind of stocks. | Country of origin. | | | | | | | | | Total. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Chile. | Costa Rica. | England. | France. | Germany. | Holland. | Ireland. | Italy. | Scotland. | Spain. | |
| Fruit: | | | | | | | | | | | |
| Apple | | | 180 | 3,357,030 | | 388,200 | | 175,500 | | | 3,920,910 |
| Cherry | | | | 7,953,710 | 150,100 | 2,078,715 | | | | | 10,182,525 |
| Grape | 2,000 | | | 6,000 | | | | 200 | | 2,640 | 10,840 |
| Pear | | | | 2,519,660 | | 366,134 | | 151,500 | | | 3,037,294 |
| Pineapple | | 100 | | | | | | | | | 100 |
| Plum | | | | 2,755,465 | | 57,200 | | 136,000 | | | 2,948,665 |
| Quince | | | | 946,250 | | 23,500 | | 5,500 | | | 975,250 |
| Rose | | | 2,035,800 | 2,451,700 | | 2,886,909 | 161,000 | | 40,000 | | 7,575,409 |
| Nut: | | | | | | | | | | | |
| Chestnut | | | | 3,000 | | | | | | | 3,000 |
| Filbert | | | | 9,300 | | | | | | | 9,300 |
| Walnut | | | | 23,500 | | | | | | | 23,500 |
| Total number of stocks | 2,000 | 100 | 2,035,980 | 20,025,615 | 150,100 | 5,800,658 | 161,000 | 468,700 | 40,000 | 2,640 | 28,686,793 |

TABLE 2.—*Importation of bulbs.*

[Figures indicate number of bulbs.]

| Country of origin. | Crocus. | Hyacinth. | Lily. | Lily of the valley. | Narcissus. | Tulip. | Unclassified. | Total. |
|---|---|---|---|---|---|---|---|---|
| Azores | | | 27,950 | | | | | 27,950 |
| Bermuda | | | 308,145 | | 3,850 | | | 311,995 |
| China | | | 300 | | 1,278,924 | | | 1,279,224 |
| England | 230 | | 7,055 | 12 | 438,003 | 4,164 | | 449,464 |
| France | | 853,395 | 296,801 | | 39,376,310 | 98,405 | | 40,624,911 |
| Germany | | | | 18,139,025 | | | | 18,139,025 |
| Holland | 8,286,070 | 28,282,827 | 300,272 | 1,464,055 | 34,348,250 | 76,610,547 | 183,900 | 149,475,921 |
| Italy | | 6,200 | 12,639 | | 1,734,550 | | | 1,753,389 |
| Japan | | | 8,192,468 | | 10,694 | | | 8,203,162 |
| Sweden | 200 | 375 | | | 2,700 | 6,000 | | 9,275 |
| Total | 8,286,500 | 29,142,797 | 9,145,630 | 19,603,092 | 77,193,281 | 76,719,116 | 183,900 | 220,274,316 |

TABLE 3.—*Importation of tree seeds.*

[Figures indicate number of pounds.]

| Country of origin. | Apple. | Cherry. | Nuts and palm. | Ornamental and tree. | Pear. | Persimmon. | Plum. | Quince. | Rose. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | | | | 220 | | | | | | 220 |
| Australia | | | 29,025 | 92 | | | | | | 29,117 |
| Austria | 38 | 38 | | 3,509 | | | 896 | | | 4,481 |
| Bermuda | | | 460 | | | | | | | 460 |
| Brazil | | | 1,477 | | | | | | | 1,477 |
| Canada | | | | 928 | | | | | | 928 |
| Chile | | 85 | | | | | | | | 85 |
| China | 10 | | 5 | 1,853 | 120 | 605 | 757 | | | 3,350 |
| Cuba | | | 984 | | | | | | | 984 |
| Denmark | | | | 78 | | | | 2 | | 80 |
| England | | | | 25 | | | | | | 25 |
| France | 21,177 | 1,206 | 736 | 3,711 | 1,926 | 50 | 1,768 | 53 | | 30,627 |
| Germany | | 1,332 | | 650 | | | | | 10 | 1,992 |
| Holland | | | | | | | | | 2 | 2 |
| Italy | | | 875 | 461 | | | 540 | | | 1,876 |
| Japan | | | 1,693 | 3,435 | 5,773 | 946 | 4,302 | 191 | 802 | 17,142 |
| Poland | | | | 693 | | | | | | 693 |
| Sweden | | | | 69 | | | | | | 69 |
| West Indies | | | 260 | | | | | | | 260 |
| Total | 21,225 | 2,661 | 35,515 | 15,724 | 7,819 | 1,601 | 8,263 | 246 | 814 | 93,868 |

The distribution within the United States of the classes of nursery stock recorded in the above Tables 1, 2, and 3 is indicated in Table 4. As in previous years, imported nursery stock has been widely distributed throughout the country. The bulk of this material, with the exception of bulbs, is inspected by the various State authorities concerned.

TABLE 4.—*Distribution, by States, of nursery stock and seeds imported under regular permit.*

[Figures indicate number of cases unless otherwise designated.]

| State. | Bulbs. | Fruit stocks. | Rose stocks. | Nut stocks. | Seeds (by pounds.) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Fruit. | Nut and palm. | Ornamental and tree. | Rose. | Total. |
| Alabama | 365 | 2 | 2 | | | 93 | 245 | | 338 |
| Alaska | 2 | | | | | | | | |
| Arizona | 70 | | | | | | | | |
| Arkansas | 257 | 13 | | | | | | | |
| California | 4,924 | 45 | | | 7,246 | 9,783 | 1,139 | | 18,168 |
| Colorado | 887 | | 3 | | | 4 | 7 | 2 | 13 |
| Connecticut | 2,323 | 70 | 111 | | 100 | 545 | 32 | 50 | 727 |
| Delaware | 340 | | | | | | | | |
| District of Columbia | 601 | | | | 15 | 7 | | | 22 |
| Florida | 108 | 4 | 1 | | | 6,901 | 262 | | 7,163 |
| Georgia | 912 | 8 | 1 | | 220 | | 358 | 10 | 588 |
| Idaho | 93 | | | | | | | | |
| Illinois | 27,981 | 5 | 74 | | 427 | 1,706 | 6,161 | 110 | 8,404 |
| Indiana | 1,564 | 68 | 96 | | | | | | |
| Iowa | 1,602 | 255 | 16 | | 3,748 | | 306 | | 4,054 |
| Kansas | 731 | 35 | | | 12,607 | | 403 | | 13,010 |
| Kentucky | 821 | 1 | | | | 30 | | | 30 |
| Louisiana | 202 | | | | | 390 | 21 | | 411 |
| Maine | 469 | | | | | | | | |
| Maryland | 1,257 | 13 | 5 | | | 9 | | 10 | 19 |
| Massachusetts | 7,428 | 3 | 10 | | | 110 | 650 | | 760 |
| Michigan | 4,425 | 88 | 13 | | | | 8 | | 3 |
| Minnesota | 2,096 | | 3 | | | 61 | | | 61 |
| Mississippi | 217 | | | | | | 3 | | 8 |
| Missouri | 1,761 | 38 | 7 | | 3,687 | 75 | | | 3,762 |
| Montana | 232 | | | | | 86 | | | 86 |
| Nebraska | 593 | 4 | | | | | | | |
| Nevada | 16 | | | | | | | | |
| New Hampshire | 245 | | | | | | 319 | | 319 |
| New Jersey | 6,970 | 26 | 119 | | 23 | 6,447 | 280 | 475 | 7,225 |
| New Mexico | 55 | | | | | | | | |
| New York | 51,361 | 700 | 266 | 5 | 7 | 2,517 | 372 | 50 | 2,946 |
| North Carolina | 595 | 7 | | | | 35 | 38 | | 73 |
| North Dakota | 133 | | | | 42 | | | | 42 |
| Ohio | 8,320 | 109 | 106 | 4 | 4 | 1,116 | 25 | | 1,145 |
| Oklahoma | 440 | 2 | | | | | | | |
| Oregon | 1,157 | 5 | | | 2,449 | 389 | 144 | 3 | 2,985 |
| Pennsylvania | 19,040 | 38 | 33 | 1 | 7,679 | 4,812 | 4,379 | 102 | 16,972 |
| Rhode Island | 1,495 | | 1 | | | | | | |
| South Carolina | 325 | | | | | | | | |
| South Dakota | 116 | | | | | | | | |
| Tennessee | 1,046 | 12 | 3 | | | | 1 | | 1 |
| Texas | 1,232 | 6 | | | 1 | 259 | 105 | | 365 |
| Utah | 262 | 2 | | | | | | | |
| Vermont | 294 | | | | | | | | |
| Virginia | 1,489 | 3 | 3 | | 50 | 7 | | | 57 |
| Washington | 1,864 | 17 | | | 3,432 | 7 | 219 | 2 | 3,660 |
| West Virginia | 556 | | | | 2 | | | | 2 |
| Wisconsin | 2,693 | | 6 | | 76 | 31 | 247 | | 354 |
| Wyoming | 46 | | | | | | | | |
| Exported by permittees | 302 | 3 | | | | 95 | | | 95 |
| Total | 162,313 | 1,582 | 879 | 10 | 41,815 | 35,515 | 15,724 | 814 | 93,868 |

The record of entry under special permits issued under regulation 14 of Quarantine 37 for the purpose of keeping the country supplied with new varieties and necessary propagating stock and to meet any other technical or educational need is given in the following table.

During the fiscal year 1923, 897 such permits were issued covering the entry of 15,175,003 plants and bulbs. Importations during the year were made under 719 of these special permits, involving 10,357,406 plants and bulbs. In addition to the record for 1923, a summary for previous years is included. It will be noted that since the promulgation of the quarantine in 1919, 16,113 varieties of plants have been under consideration for entry under this regulation. Of these 14,902 have been approved for entry.

TABLE 5.—*Special permit importations, fiscal year 1923, with combined totals for 1920, 1921, 1922, and 1923.*

| Class of plants. | Fiscal year 1923. | | | | Grand totals, 1920–1923. | | | |
|---|---|---|---|---|---|---|---|---|
| | Permits issued. | | Permits imported. | | Permits issued. | | Permits imported. | |
| | Number. | Quantity. | Number. | Quantity. | Number. | Quantity. | Number. | Quantity |
| Gladioli | 154 | 8,150,936 | 111 | 6,417,430 | 506 | 26,329,183 | 354 | 14,075,035 |
| Dahlias | 56 | 4,542 | 44 | 3,804 | 199 | 15,751 | 148 | 10,320 |
| Iris (rhizomatous) | 149 | 66,535 | 131 | 15,725 | 359 | 98,270 | 272 | 32,495 |
| Iris (bulbous) | 137 | 3,853,552 | 81 | 2,155,349 | 253 | 13,053,932 | 135 | 6,926,221 |
| Peonies | 117 | 191,719 | 95 | 92,064 | 319 | 732,259 | 223 | 188,634 |
| Other bulbs, rhizomes, and roots | 107 | 1,592,300 | 71 | 697,796 | 292 | 5,345,791 | 173 | 1,997,437 |
| Ornamentals | 126 | 424,918 | 100 | 342,991 | 341 | 1,586,184 | 223 | 1,022,466 |
| Roses | 65 | 13,366 | 64 | 6,752 | 230 | 71,040 | 173 | 51,646 |
| Orchids | 83 | 14,823 | 81 | 14,227 | 225 | 54,995 | 190 | 32,335 |
| Herbaceous plants | 106 | 860,892 | 88 | 611,231 | 291 | 2,173,760 | 180 | 981,353 |
| Fruits (small) | 7 | 1,420 | 2 | 37 | 28 | 4,894 | 9 | 319 |
| Total | ..... | 15,175,003 | ..... | 10,357,406 | ..... | 49,466,059 | ..... | 25,318,261 |

*Summary for the years 1920–1923.*

| Fiscal year. | Permits issued. | | Permits imported. | |
|---|---|---|---|---|
| | Number. | Quantity. | Number. | Quantity. |
| 1920 | 311 | 10,752,844 | 171 | 3,484,195 |
| 1921 | 622 | 13,965,013 | 411 | 8,132,634 |
| 1922 | 750 | 9,573,199 | 518 | 3,344,026 |
| 1923 | 897 | 15,175,003 | 719 | 10,357,406 |
| Grand total | 2,580 | 49,466,059 | 1,819 | 25,318,261 |

TABLE 6.—*Number of different varieties of plants requested and approved for the fiscal years 1920–1923.*

| Class of plants. | Requested. | Approved. | Per cent approved. |
|---|---|---|---|
| Gladioli | 823 | 722 | 87.7 |
| Dahlias | 1,723 | 1,646 | 95.5 |
| Iris (rhizomatous) | 1,690 | 1,644 | 97.2 |
| Iris (bulbous) | 273 | 273 | 100.0 |
| Peonies | 1,366 | 1,223 | 89.5 |
| Other bulbs, rhizomes, and roots | 1,190 | 1,155 | 97.1 |
| Ornamentals | 3,280 | 2,878 | 87.7 |
| Roses | 1,703 | 1,452 | 85.3 |
| Orchids | 2,096 | 2,038 | 97.2 |
| Herbaceous plants | 1,850 | 1,755 | 94.9 |
| Fruits (small) | 119 | 116 | 97.0 |
| Grand totals | 16,113 | 14,902 | 92.5 |

## IMPORTATIONS OF COTTON AND COTTON PRODUCTS.

For a general discussion of cotton and cotton-products imports, and revision of the cotton regulations, see pages 15, 16.

The following tables indicate, respectively, the importations of cotton, cotton waste, bagging, cotton seed, seed cotton, and cottonseed products during the fiscal year.

The actual number of bales of cotton, cotton waste, and bagging is indicated, but, inasmuch as the bales vary in size, they are referred to as "running bales."

TABLE 7.—*Imports of ginned cotton, by port of entry and country of growth, 1922–23.*

[Running bales.]

| Ports. | Brazil. | British West Indies. | China. | Colombia. | Dominican Republic. | Dutch East Indies. | Dutch Guiana. | Ecuador. | Egypt. | Haiti. | India. | Mexico. | Peru. | Porto Rico. | Syria. | United States. | Unknown. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boston | 5 | ... | 6,868 | .. | ... | 194 | .. | ... | 197,284 | 32 | 11,632 | ..... | 978 | ..... | ... | 15,848 | ... | 232,841 |
| Buffalo | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 142 | ... | 142 |
| Calexico | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | 48,342 | ..... | ..... | ... | ..... | ... | 148,342 |
| Charleston | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 50 | ... | 50 |
| Detroit | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 23 | ... | 23 |
| Fall River | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 142 | ... | 142 |
| New Orleans | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 160 | ... | 160 |
| New York | 419 | 59 | 16,656 | 10 | 218 | 5 | 19 | 201 | 40,104 | 9,246 | 15,131 | 4,951 | 72,920 | 1,850 | 325 | 6,451 | 460 | 169,025 |
| Niagara Falls | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 1,012 | ... | 1,012 |
| Philadelphia | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 42 | ... | 42 |
| Port Huron | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 1 | ... | 1 |
| Portland, Oreg | ... | ... | 75 | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ... | 75 |
| Richford | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 13 | ... | 13 |
| St. Albans | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 341 | ... | 341 |
| San Francisco | ... | ... | 14,383 | .. | ... | ... | .. | ... | ..... | ..... | 200 | ..... | ..... | ..... | ... | ..... | ... | 14,583 |
| Seattle | ... | ... | 14,410 | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | ..... | ... | 14,410 |
| Utica | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 14 | ... | 14 |
| Vanceboro | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 79 | ... | 79 |
| Wilmington, Calif | ... | ... | ..... | .. | ... | ... | .. | ... | ..... | ..... | ..... | ..... | ..... | ..... | ... | 101 | ... | 101 |
| Total | 424 | 59 | 52,392 | 10 | 218 | 199 | 19 | 201 | 237,388 | 9,278 | 26,963 | 53,293 | 73,898 | 1,850 | 325 | 24,419 | 460 | 481,396 |

[1] Includes 7,964 bales unginned cotton from Imperial Valley, Lower California, Mexico.

TABLE 8.—*Imports of cotton waste, by country of origin and port of entry, 1922–23.*

[Running bales.]

| Country. | Baltimore. | Boston. | Charleston. | New Orleans. | New York. | Norfolk. | Philadelphia. | Portland, Oreg. | San Francisco. | Savannah. | Seattle. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | | 281 | | 117 | 959 | | 191 | | | 43 | | 1,591 |
| British West Indies | | | | | 1 | | | | | | | 1 |
| Canada | | 2,197 | | | 156 | | | | | | | 2,353 |
| China | | 2,132 | | | 5,801 | | 75 | 486 | 420 | | 2,124 | 11,038 |
| Colombia | | | | | 34 | | | | | | | 34 |
| Denmark | | | | | 115 | | | | | | | 115 |
| Egypt | | 300 | | | | | | | | | | 300 |
| England | 417 | 46,434 | 4,364 | 9,807 | 7,704 | 191 | 4,416 | | 50 | 116 | | 73,499 |
| France | | 2,953 | 66 | | 1,650 | | | | | | | 4,669 |
| Germany | | 2,159 | | | 2,201 | | 539 | | 401 | | | 5,300 |
| Holland | 318 | 29,394 | | 260 | 4,400 | | 780 | | 32 | 147 | | 35,331 |
| India | | 430 | | | 8,361 | | 600 | | | | | 9,391 |
| Italy | 151 | 2,196 | | | 3,819 | | 604 | | | | | 6,770 |
| Japan | | 1,121 | | | 7,219 | | 1,406 | 651 | 1,301 | | 6,304 | 18,002 |
| Mexico | | | | | 4,062 | | | | | | | 4,062 |
| Scotland | | | | | 272 | | 10 | | | | | 282 |
| Spain | | | | | 1,554 | | | | | | | 1,554 |
| Switzerland | 484 | 11,449 | 269 | | 1,127 | 46 | 463 | | 490 | | | 14,328 |
| United States | 50 | 1,030 | 33 | | 538 | 245 | 31 | 418 | | | | 2,345 |
| Total | 1,420 | 102,076 | 4,732 | 10,184 | 49,973 | 482 | 9,115 | 1,555 | 2,694 | 306 | 8,428 | 190,965 |

TABLE 9.—*Imports of bagging, by country of origin and port of entry, 1922–23.*

[Running bales.]

| Country. | Baltimore. | Boston. | Charleston. | Detroit. | Galveston. | New Orleans | New York. | Norfolk. | Philadelphia. | Port Huron. | Portland. | Richford. | St. Albans. | Savannah. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Austria | | | 633 | | | | | | | | | | | | 633 |
| Belgium | 2,228 | 292 | 4,476 | | 157 | 3,547 | 10,755 | 136 | 4,884 | | | | | 689 | 27,164 |
| Canada | | | | 1,197 | 654 | | 2,318 | | 160 | 760 | | 33 | 158 | | 5,280 |
| Denmark | 453 | | | | | | 466 | | | | | | | | 919 |
| England | 2,952 | 7,301 | 4,852 | | 251 | 11,727 | 11,828 | 14,622 | 7,889 | | | | | 129 | 61,551 |
| France | 1,409 | 71 | 380 | | | 4,683 | 12,353 | 617 | 2,484 | | | | | | 21,997 |
| Germany | 535 | | 3,081 | | | 552 | 2,995 | | 127 | | | | | | 7,290 |
| Holland | 271 | | 1,196 | | | | 11,656 | 975 | 1,705 | | | | | | 15,803 |
| India | | | | | | | 9 | | | | | | | | 9 |
| Ireland | | | | | | | 231 | | | | | | | | 231 |
| Italy | | | | | | 189 | 145 | | | | | | | | 334 |
| Japan | | | | | | | | | | | 791 | | | | 791 |
| Scotland | 182 | | 50 | | | | 2,707 | | 474 | | | | | | 3,413 |
| Spain | | | 4,895 | | | 775 | 1,712 | | 51 | | | | | | 7,433 |
| Switzerland | | | 165 | | | | 20 | | | | | | | | 185 |
| Wales | | | | | | | 44 | | | | | | | | 44 |
| Total | 8,030 | 7,664 | 19,728 | 1,197 | 1,062 | 21,473 | 57,239 | 16,350 | 17,771 | 760 | 791 | 33 | 158 | 818 | 153,077 |

TABLE 10.—*Imports of cottonseed, seed cotton, and cottonseed products, 1922–23.*

| Port of entry. | Cotton-seed. | Seed cotton. | Cotton-seed cake. | Cotton-seed meal. |
|---|---|---|---|---|
| | *Tons.* | *Tons.* | *Tons.* | *Tons.* |
| Boston | | | 769 | 10 |
| Calexico | 24,731 | 5,973 | | |
| Eagle Pass | | | 402 | |
| Total | 24,731 | [1] 5,973 | 1,171 | 10 |

[1] Shown in cotton tables as 7,964 bales of unginned cotton.

## IMPORTATIONS OF FRUITS AND VEGETABLES UNDER QUARANTINE 49.

The entry of fruits and vegetables from Cuba, the Bahamas, Jamaica, Canal Zone, Costa Rica, India, Philippine Islands, Ceylon, and Java is restricted under Quarantine 49, on account of the black fly. The records of importations under this quarantine for the year are given in the following tables:

TABLE 11.—*Fruit and vegetables imported under Quarantine No. 49 during fiscal year ended June 30, 1923, by countries of origin.*

| Kind. | Bahamas. | Canal Zone. | Costa Rica. | Cuba. | Jamaica. | Philippine Islands. | Total. |
|---|---|---|---|---|---|---|---|
| Avocadoes.....crates.. | 8 | | | 57,092 | 9 | | 57,109 |
| Bananas.....bunches.. | 52 | 563,300 | 3,485,756 | 1,742,519 | 10,033,261 | 10 | 15,824,898 |
| Beans.....crates.. | | | | 316 | | | 316 |
| Beets.....do.... | 38 | | | 292 | | | 330 |
| Carrots.....do.... | 147 | | | 349 | | | 496 |
| Cassava.....do.... | | | | 1,488 | | | 1,488 |
| Coconuts.....number.. | 15,150 | 14,869,444 | 138,360 | 1,206,200 | 21,211,577 | | 37,440,731 |
| Copra.....bags.. | | 18 | | 100 | 6,933 | | 7,051 |
| Cucumbers.....crates.. | | | | 374 | | | 374 |
| Eggplants.....do.... | | | | 64,218 | | | 64,218 |
| Grapefruit.....do.... | 350 | | 567 | 261,653 | 593 | | 263,163 |
| Lima beans.....do.... | | | | 20,361 | | | 20,361 |
| Limes.....do.... | | | 388 | 181 | 82 | | 651 |
| Malangas.....do.... | | | | 786 | | | 786 |
| Mammeas.....do.... | 2 | | | 1,540 | | | 1,542 |
| Mangoes.....do.... | | | | 8,638 | 207 | 1 | 8,846 |
| Okra.....do.... | | | | 7,197 | | | 7,197 |
| Onions.....do.... | | | | 14,108 | | | 14,108 |
| Oranges.....do.... | | | 2,702 | 5,122 | 1,796 | | 9,620 |
| Parsley.....do.... | 64 | | | 182 | | | 246 |
| Peas.....do.... | | | | 107 | 35 | | 142 |
| Peppers.....do.... | 31 | | | 161,564 | 447 | | 162,042 |
| Pineapples.....do.... | 782 | 1,344 | 23,744 | 1,377,395 | 985 | | 1,404,250 |
| Plantains.....bunches.. | 6 | 1,378 | 71 | 80,107 | 147 | | 81,709 |
| Pumpkins.....crates.. | | 74 | | 215 | 37 | | 326 |
| Sapodillas.....do.... | 452 | | | 3 | | | 455 |
| Sour sops.....do.... | 6 | | | 271 | | | 277 |
| Squash.....do.... | | | | 2,040 | | | 2,040 |
| Tangerines.....do.... | | | 6 | 246 | | | 252 |
| Tomatoes.....do.... | 150,277 | | | 169,653 | | | 319,930 |
| Not specified.....do.... | 6 | | | 657 | 8 | | 671 |
| Miscellaneous: | | | | | | | |
| Fruit.....do.... | | | | 143 | 3 | | 146 |
| Vegetables.....do.... | | | | 184 | 72 | | 256 |

TABLE 12.—*Fruits and vegetables imported under Quarantine No. 49 during fiscal year ended June 30, 1923, by ports of entry.*

| Kind. | Baltimore, Md. | Boston, Mass. | Key West, Fla. | Los Angeles, Calif. | Miami, Fla. | New Orleans, La. |
|---|---|---|---|---|---|---|
| Avocadoes.....crates | | 2 | 13,165 | | 8 | 22,017 |
| Bananas.....bunches | 2,437,200 | 1,668,736 | 6,262 | 11 795 | 41,404 | 533,288 |
| Beans.....crates | | | 87 | | | 89 |
| Beets.....do | | | | | | |
| Carrots.....do | | | | | | |
| Cassava.....do | | | 373 | | | |
| Coconuts.....number | 1,493.800 | 75,000 | 2,000 | | 14,650 | 1,322,900 |
| Copra.....bags | | | | | | |
| Cucumbers.....crates | | | 9 | | | 2 |
| Eggplants.....do | | | 4.300 | | | 3,532 |
| Grapefruit.....do | 2 | 259 | 121,847 | | | 5,595 |
| Lima beans.....do | | | 185 | | | 221 |
| Limes.....do | | | | | | 127 |
| Malangas.....do | | | 253 | | | |
| Mammeas.....do | | | 327 | | 2 | 170 |
| Mangoes.....do | | 2 | | | | 6,545 |
| Okra.....do | | | 254 | | | 3,071 |
| Onions.....do | | | 100 | | | |
| Oranges.....do | | 412 | 4,195 | | | 768 |
| Parsley.....do | | | | | | |
| Peas.....do | | | | | | 5 |
| Peppers.....do | 447 | | 2,588 | | 29 | 1,241 |
| Pineapples.....do | 482 | 6,887 | 1,045,158 | | 454 | 34,130 |
| Plantains.....bunches | | 38 | 28,227 | | 36 | |
| Pumpkins.....crates | | | 23 | | | 74 |
| Sapodillas.....do | | | | | 452 | |
| Sour sops.....do | | | 140 | | 6 | 1 |
| Squash.....do | | | 35 | | | 2 |
| Tangerines.....do | | 3 | 242 | | | |
| Tomatoes.....do | | | 50,386 | | 80,317 | 48,847 |
| Not specified.....do | | | 1 | | 6 | |
| Miscellaneous: | | | | | | |
| Fruits.....do | | | 28 | | | 7 |
| Vegetables.....do | | | 6 | | | 73 |

| Kind. | New York, N. Y. | Norfolk, Va. | Philadelphia, Pa. | Savannah, Ga. | Tampa, Fla. | Seattle, Wash. | Total. |
|---|---|---|---|---|---|---|---|
| Avocadoes.....crates | 8,727 | | | | 13,190 | | 57,109 |
| Bananas.....bunches | 8,171,718 | 8,345 | 2,944,728 | 1,400 | 12 | 10 | 15,824,898 |
| Beans.....crates | 21 | | | | 119 | | 316 |
| Beets.....do | 330 | | | | | | 330 |
| Carrots.....do | 496 | | | | | | 496 |
| Cassava.....do | 989 | | | | 126 | | 1,488 |
| Coconuts.....number | 31,522,656 | | 2,981,725 | 28,000 | | | 37,440,731 |
| Copra.....bags | 7,011 | | 40 | | | | 7,051 |
| Cucumbers.....crates | 363 | | | | | | 374 |
| Eggplants.....do | 56,386 | | | | | | 64,218 |
| Grapefruit.....do | 135,422 | | | | 38 | | 263,163 |
| Lima beans.....do | 19,955 | | | | | | 20,261 |
| Limes.....do | 524 | | | | | | 651 |
| Malangas.....do | 118 | | | | 415 | | 786 |
| Mammeas.....do | | | | | 1,043 | | 1,542 |
| Mangoes.....do | 2,298 | | | | | 1 | 8,846 |
| Okra.....do | 3,778 | | | | 94 | | 7,197 |
| Onions.....do | 14,007 | | | | 1 | | 14,108 |
| Oranges.....do | 4,049 | | 112 | 75 | 9 | | 9,620 |
| Parsley.....do | 246 | | | | | | 246 |
| Peas.....do | 137 | | | | | | 142 |
| Peppers.....do | 157,692 | | | | 45 | | 162,042 |
| Pineapples.....do | 313,358 | | | | 3,781 | | 1,404.250 |
| Plantains.....bunches | 2,917 | | | | 50,491 | | 81,709 |
| Pumpkins.....crates | 179 | | | | 50 | | 326 |
| Sapodillas.....do | | | | | 3 | | 455 |
| Sour Sops.....do | | | | | 130 | | 277 |
| Squash.....do | 2,003 | | | | | | 2,040 |
| Tangerines.....do | 7 | | | | | | 252 |
| Tomatoes.....do | 140,336 | | | | 44 | | 319,930 |
| Not specified.....do | 664 | | | | | | 671 |
| Miscellaneous: | | | | | | | |
| Fruits.....do | 25 | | | | 86 | | 146 |
| Vegetables.....do | 169 | | | | 8 | | 256 |

## IMPORTATIONS OF BROOMS AND BROOMCORN.

The record kept by the board of the importation of broomcorn, including manufactured brooms, is a matter of special interest on account of its relation to the important corn borer subject. (See discussion under "European corn borer," p. 6.) A statement is given in Table 13 indicating the quantities imported and the countries of origin of such broomcorn. As elsewhere indicated the importations this year were unusually heavy, totaling 42,000 bales of broomcorn and 13,108 bundles of brooms—all entered and sterilized through the ports of New York and Boston, with the exception of 254 bales of broomcorn from Argentina and one bale from Australia, which were entered and sterilized at the port of San Francisco. The sterilization of manufactured brooms was limited to those, usually of large size, which, from the nature of their manufacture, contained large elements of the stalk in such condition as to be a means of carrying the larvæ of the corn borer.

TABLE 13.—*Importations of brooms and broomcorn during fiscal year ended June 30, 1923.*

| Country of origin. | Brooms. | Broomcorn. | Country of origin. | Brooms. | Broomcorn. |
|---|---|---|---|---|---|
| Argentina | | 1,935 bales. | Italy | 277 bales, 126 bundles, 24 packages. | 10,813 bales, 1 package. |
| Australia | | 1 bale. | | | |
| Austria | 493 bundles | | | | |
| Belgium | 1 bundle | | Yugo Slavia | 12,000 brooms | |
| Germany | 2,153 bundles | 743 bales. | Rumania | 2 bales, 1,899 bundles, 2 cases. | 8 cases, 3 bags. |
| Hungary | 480 bundles, 7,500 brooms. | 28,446 bales, 2,447 bundles, 51 bags, 1 package. | Spain | 31 bales | |

## IMPORTATIONS OF OTHER RESTRICTED PLANT PRODUCTS.

In addition to the foregoing record of plants and plant products, the board has supervised the importation under quarantine of 16,391 bushels of potatoes from Mexico, 45,121 cases of Satsuma oranges from Japan, and to insure freedom from earth 30,549 packages of horseradish.

The board has also supervised and safeguarded importation for immediate exportation in bond to other countries of considerable quantities of prohibited or restricted plants and plant products.

## TERMINAL INSPECTION OF MAIL SHIPMENTS OF PLANTS AND PLANT PRODUCTS.

Arrangements were made during the fiscal year 1923 by Oregon for terminal inspection of mail shipments of plants and plant products under the authority of the act of March 4, 1915, and the terminal inspection points in Hawaii, Utah, California, and Washington were revised. California, Arizona, Montana, Florida, Washington, Arkansas, the District of Columbia, Mississippi, the Territory of Hawaii, and Utah had previously, in the order named, availed themselves of the provisions of the act referred to. Such terminal inspection is conducted entirely at the expense of the States concerned and has proved to be of great value to the board in

the enforcement of its domestic quarantines. This is particularly true of our white pine blister rust quarantines.

## CONVICTIONS FOR VIOLATIONS OF THE PLANT QUARANTINE ACT.

During the year the solicitor of the department reported 49 convictions for violations of the plant quarantine act, 11 in regard to the gipsy moth and brown-tail moth quarantine, 34 in regard to the white pine blister rust quarantine, 2 in regard to the Mediterranean fruit fly and melon fly quarantine, and 1 each in regard to the European corn borer quarantine and the avocado or alligator pear quarantine. Fines aggregating $1,920 and costs were imposed.

## NEW AND REVISED PLANT QUARANTINES.

The following quarantines and other restrictive orders have been either promulgated or revised during the period, July 1, 1922, to the date of the preparation of this report, October 1, 1923:

*Domestic quarantines.*—The European corn borer quarantine, amended July 28, 1922, September 2, 1922, November 16, 1922, and March 26, 1923; the Mediterranean fruit fly and melon fly quarantine, revised October 9, 1922; the black stem rust quarantine, amended December 26, 1922; the white pine blister rust quarantine (No. 54), amended March 2, 1923; the pink bollworm quarantine, revised May 19, 1923, and amended October 8, 1923; the Japanese beetle quarantine, revised April 9, 1923; and the gipsy moth and browntail moth quarantine, amended June 6, 1923, and August 21, 1923.

*Foreign quarantines.*—The nursery stock, plant, and seed quarantine, amended October 13, 1922, and December 18, 1922, and revised April 5, 1923; the European corn borer quarantine, revised August 4, 1923; the seed or paddy rice quarantine, promulgated July 17, 1923; and the fruit and vegetable quarantine, promulgated August 1, 1923.

*Other restrictive orders.*—Regulations governing the importation of cotton and cotton wrappings into the United States, revised February 24, 1923; and regulations governing the importation of potatoes into the United States, amended January 17, 1923 (withdrawn February 13, 1923).

The Federal Horticultural Board is now enforcing 22 foreign and 15 domestic quarantines.

A list of the domestic and foreign quarantines and other restrictive orders as now in force follows.

# LIST OF CURRENT QUARANTINE AND OTHER RESTRICTIVE ORDERS.

## QUARANTINE ORDERS.

The numbers assigned to these quarantines indicate merely the chronological order of issuance of both domestic and foreign quarantines in one numerical series. The quarantine numbers missing in this list are quarantines which have either been superseded or revoked. For convenience of reference these quarantines are here classified as domestic and foreign.

### DOMESTIC QUARANTINES.

*Date palms.*—Quarantine No. 6: Regulates the interstate movement of date palms and date-palm offshoots from Riverside County, Calif., east of the San Bernardino meridian; Imperial County, Calif.; Yuma, Maricopa, and Pinal Counties, Ariz.; and Webb County, Tex.; on account of the Parlatoria scale (*Parlatoria blanchardi*) and the Phoenicococcus scale (*Phoenicococcus marlatti*).

*Hawaiian fruits.*—Quarantine No. 13, revised: Prohibits or regulates the importation from Hawaii of all fruits and vegetables, in the natural or raw state, on account of the Mediterranean fruit fly and the melon fly.

*Sugar cane.*—Quarantine No. 16: Prohibits the importation from Hawaii and Porto Rico of living canes of sugar cane, or cuttings or parts thereof, on account of certain injurious insects and fungous diseases.

*Five-leafed pines, Ribes and Grossularia.*—Quarantine No. 26, as amended: Prohibits the interstate movement of five-leafed pines, currant, and gooseberry plants from all States east of and including the States of Minnesota, Iowa, Missouri, Arkansas, and Louisiana to points outside of this area; prohibits further (1) the interstate movement of five-leafed pines and black-currant plants to points outside the area comprising the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York, and, (2) to protect the State of New York, the movement from the New England States, on account of the white pine blister rust.

*Sweet potato and yam.*—Quarantine No. 30: Prohibits the movement from the Territories of Hawaii and Porto Rico into or through any other Territory, State, or District of the United States of all varieties of sweet potatoes and yams (*Ipomoea batatas* and *Dioscorea* spp.), regardless of the use for which the same are intended, on account of the sweet-potato weevil (*Cylas formicarius*) and the sweet-potato scarabee (*Euscepes batatæ*).

*Banana plants.*—Quarantine No. 32: Prohibits the movement from the Territories of Hawaii and Porto Rico into or through any other Territory, State, or District of the United States of any species or variety of banana plants (*Musa* spp.), regardless of the use for which the same are intended, on account of two injurious weevils, *Rhabdocnemis obscurus* and *Metamasius hemipterus*.

*Black stem rust.*—Quarantine No. 38 as amended: Prohibits the movement interstate to any point outside of the quarantined area of the common barberry and its horticultural varieties as well as certain other species of Berberis and Mahonia, on account of the black stem rust of wheat, oats, barley, rye, and many wild and cultivated grasses.

*European corn borer.*—Quarantine No. 43 (second revision) as amended: Regulates the movement interstate to any point outside of the quarantined area of (1) corn and broomcorn (including all parts of the stalk), all sorghums, sudan grass, celery, green beans in the pod, beets with tops, spinach, rhubarb, oat and rye straw as such or when used as packing, cut flowers or entire plants of chrysanthemum, aster, cosmos, zinnia, hollyhock, and cut flowers or entire plants of gladiolus and dahlia, except the bulbs thereof, without stems, from infested areas in Maine, New Hampshire, Massachusetts, and Rhode Island, and (2) corn and broomcorn (including all parts of the stalk), all sorghums, and sudan grass from infested areas in New York, Pennsylvania, Ohio, and Michigan on account of the European corn borer (*Pyrausta nubilalis*).

*Gipsy moth and brown-tail moth.*—Quarantine No. 45, as amended: Regulates the movement interstate to any point outside of the quarantined towns and territory, or from points in the generally infested area to points in the lightly infested area, of stone or quarry products, and of the plants and the plant products listed therein. The quarantine covers all the New England States.

*Hawaiian and Porto Rican cotton, cottonseed, and cottonseed products.*—Quarantine No. 47: Regulates the movement of cotton, cottonseed, and cottonseed products from Hawaii and Porto Rico on account of the pink bollworm and the cotton blister mite, respectively.

*Japanese beetle.*—Quarantine No. 48, revised: Regulates the movement interstate to any point outside of certain portions of the counties of Mercer, Burlington, Gloucester, and Camden, N. J., and certain portions of the counties of Delaware, Chester, Philadelphia, Montgomery, and Bucks, Pa., of the following articles: (1) The interstate movement of green, sweet, or sugar corn; cabbage, lettuce, and grapes; and unthreshed grains, straw, and forage crops, originating in the farm-products area is prohibited between June 15 and October 15, inclusive, except as to direct shipments from the point of production, namely, from the point where grown or a local packing house, to the point of destination outside of the farm-products area and under inspection and certification. The products enumerated may move interstate without restriction between October 16 and June 14, inclusive; (2) the interstate movement of soil, compost, and manure from the farm-products area is prohibited except where absolute freedom from infestation is determined by an inspector of the U. S. Department of Agriculture, or when such soil, compost, or manure has been disinfected or treated under the supervision and to the satisfaction of such inspector; (3) the interstate movement of nursery and ornamental stock, except bulbs and cut flowers, originating within the Japanese beetle area to any point outside the farm-products area, except under inspection and certification, is prohibited, on acount of the Japanese beetle (*Popillia japonica*).

*United States quarantined to protect Hawaii.*—Quarantine No. 51: Regulates the movement from the United States to the Territory of Hawaii, as ships' stores or as baggage or effects of passengers or crews, of sugar cane, corn, cotton, alfalfa, and the fruits of the avocado and papaya.

*Pink bollworm.*—Quarantine No. 52, with revised rules and regulations: Prohibits the interstate movement from the regulated areas of Texas, Louisiana, and New Mexico of cotton, including all parts of the plant, seed cotton, cotton lint, linters, gin waste and all other forms of cotton lint, cottonseed, cottonseed hulls, cottonseed cake and meal, bagging and other containers of the articles enumerated, and also railway cars, boats, and other vehicles which have been used in conveying cotton and cotton products grown in such regulated areas or which are fouled with such products, farm products other than hay, farm household goods, and farm equipment, except as provided in the rules and regulations supplemental thereto, on account of the pink bollworm of cotton (*Pectinophora gossypiella* Saunders).

*Satin moth.*—Quarantine No. 53: Prohibits the interstate movement to points outside of the infested areas in New Hampshire and Massachusetts of all species or varieties of poplar and willow on account of the satin moth (*Stilpnotia salicis* L.).

*White-pine blister rust.*—Quarantine No. 54, as amended: Prohibits the movement from the State of Washington of five-leafed pines, currant and gooseberry plants, on account of the white-pine blister rust.

### FOREIGN QUARANTINES.

*Irish potatoes.*—Quarantine No. 3: Prohibits the importation of the common or Irish potato from Newfoundland; the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales, and Ireland; Germany; and Austria-Hungary, on account of the disease kown as potato wart.

*Mexican fruits.*—Quarantine No. 5, as amended: Prohibits the importation of oranges, sweet limes, grapefruit, mangoes, achras sapotes, peaches, guavas, and plums from the Republic of Mexico, on account of the Mexican fruit fly.

*Five-leafed pines, Ribes, and Grossularia.*—Quarantine No. 7, as amended: Prohibits the importation from each and every country of Europe and Asia, and from the Dominion of Canada and Newfoundland, of all five-leafed pines and all species and varieties of the genera *Ribes* and *Grossularia*, on account of the white-pine blister rust.

*Cottonseed and cottonseed hulls.*—Quarantine No. 8, as amended: Prohibits the importation from any foreign locality and country, excepting only the locality of the Imperial Valley, in the State of Lower California, Mexico, of cotton seed (including seed cotton) of all species and varieties, and cottonseed hulls, on account of the pink bollworm. Cotton and cottonseed from the Imperial Valley may be entered under permit and regulation.

*Seeds of avocado or alligator pear.*—Quarantine No. 12: Prohibits the importation from Mexico and the countries of Central America of the seeds of the avocado or alligator pear on account of the avocado weevil.

*Sugar cane.*—Quarantine No. 15: Prohibits the importation from all foreign countries of living canes of sugar cane, or cuttings or parts thereof, on account of certain injurious insects and fungous diseases. There are no restrictions on the entry of such materials into Hawaii and Porto Rico.

*Citrus nursery stock.*—Quarantine No. 19: Prohibits the importation from all foreign localities and countries of all citrus nursery stock, including buds, scions, and seeds, on account of the citrus canker and other dangerous citrus diseases. The term "citrus," as used in this quarantine, includes all plants belonging to the subfamily or tribe *Citratae.*

*European pines.*—Quarantine No. 20: Prohibits, on account of the European pine-shoot moth (*Evetria buoliana*), the importation from all European countries and localities of all pines not already excluded by Quarantine No. 7.

*Indian corn or maize and related plants.*—Quarantine No. 24, as amended: Prohibits the importation from southeastern Asia (including India, Siam, Indo-China, and China), Malayan Archipelago, Australia, New Zealand, Oceania, Philippine Islands, Formosa, Japan, and adjacent islands, in the raw or unmanufactured state, of seed and all other portions of Indian corn or maize (*Zea mays* L.), and the closely related plants, including all species of Teosinte (*Euchlaena*), Job's tears (*Coix*), *Polytoca, Chionachne,* and *Sclerachne,* on account of the downy mildews and *Physoderma* diseases of Indian corn, except that Indian corn or maize may be imported under permit and upon compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

*Citrus fruit.*—Quarantine No. 28: Prohibits the importation from eastern and southeastern Asia (including India, Siam, Indo-China, and China), the Malayan Archipelago, the Philippine Islands, Oceania (except Australia, Tasmania, and New Zealand), Japan (including Formosa and other islands adjacent to Japan), and the Union of South Africa, of all species and varieties of citrus fruits, on account of the citrus canker, except that oranges of the mandarin class (including satsuma and tangerine varieties) may be imported under permit and upon compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

*Sweet potato and yam.*—Quarantine No. 29: Prohibits the importation for any purpose of any variety of sweet potatoes or yams (*Ipomoea batatas* and *Dioscorea* spp.) from all foreign countries and localities, on account of the sweet-potato weevils (*Cylas* spp.) and the sweet-potato scarabee (*Euscepes batatae*).

*Banana plants.*—Quarantine No. 31: Prohibits the importation for any purpose of any species or variety of banana plants (*Musa* spp.), or portions thereof, from all foreign countries and localities, on account of the banana-root borer (*Cosmopolites sordidus*). No restrictions are placed on the importation of the fruit of the banana.

*Bamboo.*—Quarantine No. 34: Prohibits the importation for any purpose of any variety of bamboo seed, plants, or cuttings thereof capable of propagation, including all genera and species of the tribe *Bambuseae,* from all foreign countries and localities, on account of dangerous plant diseases, including the bamboo smut (*Ustilago shiraiana*). This quarantine order does not apply to bamboo timber consisting of the mature dried culms or canes which are imported for fishing rods, furniture making, or other purposes, or to any kind of article manufactured from bamboo, or to bamboo shoots cooked or otherwise preserved.

*Nursery stock, plants, and seeds.*—Quarantine No. 37, with regulations, revised: Prohibits the importation of nursery stock and other plants and seeds from all foreign countries and localities, on account of certain injurious insects and fungous diseases, except as provided in the regulations. Under this quarantine the following plants and plant products may be imported without restriction: Fruits, vegetables, cereals, and other plant products imported for medicinal, food, or manufacturing purposes, and field, vegetable, and flower seeds. The entry of the following nursery stock and other plants and seeds is permitted under permit:

(1) Bulbs of the following genera: Lilium (lily), Convallaria (lily of the valley), Hyacinthus (hyacinth), Tulipa (tulip), and Crocus; and, for a period not exceeding three years from January 1, 1923, Chionodoxa (glory-of-the-snow), Galanthus (snowdrop), Scilla (squill), *Fritillaria imperialis* (crown imperial), *Fritillaria meleagris* (guinea-hen flower), Muscari (grape hyacinth), Ixia, Eranthis (winter aconite), and Narcissus (jonquil, daffodil, etc.).

(2) Stocks, cuttings, scions, and buds of fruits for propagation.

(3) Rose stocks for propagation, including Manetti, Multiflora, brier Rose and Rosa Rugosa.

(4) Nuts, including palm seeds, for propagation.

(5) Seeds of fruit, forest, ornamental, and shade trees, seeds of deciduous and evergreen ornamental shrubs, and seeds of hardy perennial plants.

Provision is also made for the issuance of special permits under safeguards to be prescribed in such permits for the entry in limited quantities of nursery stock and other plants and seeds not covered in the preceding lists for the purpose of keeping the country supplied with new varieties and necessary propagating stock.

*Flag smut and take-all.*—Quarantine No. 39, with regulations: Prohibits the importation of seed or paddy rice from Australia, India, Japan, Italy, France, Germany, Belgium, Great Britain, Ireland, and Brazil on account of two dangerous plant diseases known as flag smut (*Urocystis tritici*) and take-all (*Ophiobolus graminis*). Wheat, oats, barley, and rye may be imported from the countries named only under permit and upon compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

*European corn borer.*—Quarantine No. 41, with regulations, revised: Prohibits the importation of the stalk and all other parts, whether used for packing or other purposes, in the raw or unmanufactured state, of Indian corn or maize, broom corn, sweet sorghums, grain sorghums, Sudan grass, Johnson grass, sugar cane, pearl millet, napier grass, teosinte, and Job's tears, from all foreign countries and localities, except as provided in the rules and regulations supplemental thereto, on account of the European corn borer (*Pyrausta nubilalis*) and other dangerous insects and plant diseases.

*Mexican corn.*—Quarantine No. 42, with regulations: Prohibits the importation of Indian corn or maize from Mexico, except as provided in the rules and regulations supplemental thereto, on account of the contamination of such corn with cottonseed more or less infested with the pink bollworm.

*Stocks, cuttings, scions, and buds of fruits.*—Quarantine No. 44: Prohibits the importation of stocks, cuttings, scions, and buds of fruits from Asia, Japan, Philippine Islands, and Oceania (including Australia and New Zealand) on account of dangerous plant diseases, including Japanese apple cankers, blister blight, and rusts, and injurious insect pests, including the oriental fruit moth, the pear fruit borer, the apple moth, etc.

*Citrus black fly.*—Quarantine No. 49, with regulations: Prohibits the importation of fruits and vegetables and of plants or portions of plants used as packing material in connection with shipments of such fruits and vegetables, or otherwise, from Cuba, the Bahamas, Jamaica, Canal Zone, Costa Rica, India, Philippine Islands, Ceylon, and Java, except as provided in the rules and regulations supplemental thereto, on account of the citrus black fly (*Aleurocanthus woglumi*).

*Seed or paddy rice.*—Quarantine No. 55: Prohibits the importation of seed or paddy rice from all foreign countries and localities on account of injurious fungous diseases of rice, including downy mildew (*Sclerospora macrocarpa*), leaf-smut (*Entyloma oryzae*), blight (*Oospora oryztorum*), and glume blotch (*Melanomma glumarum*), as well as dangerous insect pests, except that such seed or paddy rice may be imported from the Republic of Mexico upon compliance with the conditions prescribed in the rules and regulations supplemental thereto. This quarantine is supplemental to Quarantine No. 39.

*Fruits and vegetables.*—Quarantine No. 56: Prohibits the importation of fruits and vegetables not already the subject of special quarantines or other restrictive orders, and of plants or portions of plants used as packing material in connection with shipments of such fruits and vegetables, from all foreign countries and localities other than the Dominion of Canada, except as provided in the rules and regulations supplemental thereto, on account of injurious insects, including fruit and melon flies (Trypetidae). Includes and supersedes Quarantine No. 49 on account of the citrus black fly.

## OTHER RESTRICTIVE ORDERS.

The regulation of the entry of nursery stock from foreign countries into the United States was specifically provided for in the plant quarantine act. The act further provides for the similar regulation of any other class of plants or plant products when the need therefor shall be determined. The entry of the plants and plant products listed below has been brought under such regulation:

*Nursery stock.*—The conditions governing the entry of nursery stock and other plants and seeds from all foreign countries and localities are indicated above under "Foreign quarantines." (See Quarantine No. 37, revised.)

*Irish potatoes.*—The importation of Irish potatoes is prohibited altogether from the countries enumerated in the potato quarantine. Potatoes may be admitted from other foreign countries under permit and in accordance with the provisions of the regulations issued under order of December 22, 1913, bringing the entry of potatoes under restriction on account of injurious potato diseases and insect pests. Importation of potatoes is now authorized from the following countries: Bermuda and the Dominion of Canada; also from the States of Chihuahua and Sonora, and the Imperial Valley of Lower California, Mexico. The regulations issued under this order have been amended so as to permit, free of any restrictions whatsoever under the plant quarantine act, the importation of potatoes from any foreign country into the Territories of Porto Rico and Hawaii for local use only and from the Dominion of Canada and Bermuda into the United States or any of its Territories or Districts.

*Avocado, or alligator pear.*—The order of February 27, 1914, prohibits the importation from Mexico and the countries of Central America of the fruits of the avocado, or alligator pear, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of the avocado weevil. Entry is permitted through the port of New York only and is limited to the large, thick-skinned variety of the avocado. The importation of the small, purple, thin-skinned variety of the fruit of the avocado and of avocado nursery stock under 18 months of age is prohibited.

*Cotton.*—The order of April 27, 1915, prohibits the importation of cotton from all foreign countries and localities, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of injurious insects, including the pink bollworm. These regulations apply in part to cotton grown in and imported from the Imperial Valley, in the State of Lower California, Mexico.

*Cottonseed products.*—The order of June 23, 1917, prohibits the importation of cottonseed cake, meal, and all other cottonseed products, except oil, from all foreign countries, and a second order of June 23, 1917, prohibits the importation of cottonseed oil from Mexico, except under permit and in accordance with the other provisions of the regulations issued under said orders, on account of injurious insects, including the pink bollworm.

## MISCELLANEOUS REGULATIONS.

*Rules and regulations governing (1) entry for immediate export, (2) entry for immediate transportation and exportation in bond, and (3) safeguarding the arrival at a port where entry or landing is not intended of prohibited plants and plant products.*—These rules and regulations, as revised August 1, 1920, govern the unloading and transfer of cargoes and transportation in bond when it is determined that such entry can be made without involving risk to the plant cultures of the United States, and also provide for the safeguarding at a port or within the territorial waters of the United States where entry or landing is not intended of any prohibited or restricted plants and plant products.

*Rules and regulations governing the movement of plants and plant products into and out of the District of Columbia.*—These rules and regulations were promulgated August 26, 1920, under the amendment to the plant quarantine act of May 31 of that year. They provide for the regulation of the movement of plants and plant products, including nursery stock, from or into the District of Columbia and for the control of injurious plant diseases and insect pests within the said District.

# REPORT OF THE INSECTICIDE AND FUNGICIDE BOARD.

UNITED STATES DEPARTMENT OF AGRICULTURE,
INSECTICIDE AND FUNGICIDE BOARD,
*Washington, D. C., September 8, 1923.*

SIR: I have the honor to submit herewith the report of the work of the Insecticide and Fungicide Board for the fiscal year ended June 30, 1923.

Respectfully,

J. K. HAYWOOD, *Chairman.*

HON. HENRY C. WALLACE,
*Secretary of Agriculture.*

## SUMMARY.

The insecticide and fungicide board aids the Secretary of Agriculture in the enforcement of the insecticide act of 1910. This act was designed to prevent the manufacture, sale, or transportation of insecticides or fungicides (including disinfectants) which are below the strength claimed for them, which will not accomplish the results promised, which will be injurious to vegetation, or which fail to comply with any other provision of the act, the purpose being to have labels contain only truthful statements.

The products regulated by this act are of varied character and used for multifarious purposes. The effect of the enforcement of this law is felt on the farm, cattle range, in the orchard, home, school, hospital, and all places where the human race is engaged in the unending struggle for supremacy over the armies of insects and germs, which at times take such heavy toll of life and property. All classes of people are directly benefited by the enforcement of this law.

The enforcement of this law has had a marked effect upon the industry engaged in the manufacture and sale of insecticides and fungicides, and each year sees progress in the direction of more truthful labels and a higher standard of quality in the products on the market.

The industry has made tremendous strides since the inception of this regulatory work and the board is constantly confronted with new problems. Each year sees a new crop of insecticides and fungicides. Some represent new manufactures of the recognized standard remedies, but there is always a certain percentage of new theories of treatment represented by these new articles. The board has been busily engaged in inspecting shipments and making tests to determine whether the new remedies really possess the virtues claimed for them. This work necessarily takes time, but the aim is to get conclusive results and therefore these tests must be thorough. The boll weevil has probably been the cause of the largest number of these new theories. As the result of the widespread ravages of the cotton-

boll weevil, various new, so-called remedies have appeared on the market. The board has attempted to collect all of these, with the idea of submitting them to analysis and test. This is a tremendous undertaking, and it will probably take several years' work before this situation is cleaned up and worthless preparations driven off the market. In fact, this work can not be carried to completion with our present funds, but must be pursued on a small scale until further funds can be obtained from Congress.

There have been a number of preparations encountered during the year which are represented to be effective against chicken lice and mites when fed to chickens with their food or water. Tests that have been completed so far have shown the ineffectiveness of these preparations, and the board has recommended action against the manufacturers.

The campaign inaugurated in 1919 and involving the inspection of the domestic supply of calcium arsenate used for cotton-boll weevil control was continued during the fiscal year 1923, and it was found that the composition of this article was growing more constant and satisfactory from the point of view of control and lack of burning qualities. However, enough of the offgrade material continues on the market to demand our attention.

One of the outstanding new features of our control work during the past year was the investigation of large shipments of calcium arsenate sent in from abroad. Up to the present year no calcium arsenate had been imported, but this year some large shipments came from Germany and England. Investigation showed that some of the shipments were satisfactory, while others consisted of a very poor grade of calcium arsenate that was irregular in composition and contained enough water-soluble arsenic to cause the product to be seriously injurious to cotton. Unsatisfactory shipments of calcium arsenate were, of course, excluded from the country.

The campaign designed to improve the quality and labeling of Bordeaux mixture and Bordeaux-lead arsenate was continued during the fiscal year 1923 and the labels for most of these preparations brought in entire conformity with law. Work was continued on new brands of these preparations appearing on the market and on old brands in those cases in which it will be probably necessary to take action against the manufacturers under the provisions of the law to bring about satisfactory corrections of their labels.

The campaign against so-called pine-oil disinfectants and coal-tar dips and disinfectants adulterated with mineral oil started in 1921, was continued during the fiscal year 1923, with the result that this form of adulteration has been greatly reduced. This campaign will be continued from year to year.

The campaign against adulterated and misbranded disinfectants of various kinds has been continued throughout the year. Special attention has been given to pine-oil disinfectants sold for general disinfecting purposes, whereas tests had shown that the material was not effective except against a limited class of germs, paradichlorobenzene powders and blocks, erroneously sold as disinfectants, and many new disinfectants which have appeared on the market. A great improvement has been brought about, but not such an improvement as to warrant the abandonment of the campaign.

The campaign started during the fiscal year 1919 against insect powders adulterated with daisy flowers and insect flower stems, was continued during the fiscal year 1923. This campaign will be continued from year to year.

These are a few of the more important activities of the board during the year, in addition to which there was a large amount of inspectional work required to determine whether the more commonly used remedies were being maintained at the proper standard to render them safe and effective. The inspectional records also reveal that a large number of insecticides and fungicides that had not been previously brought to the attention of the board were collected by our inspectors during the year.

It is the experience of the board that the consumers of this class of materials are too ready to purchase untried remedies, which too often results not only in the loss of the purchase price, but more important, the failure to control the conditions sought to be remedied, with the attendant damage to crops or health. It would be well for consumers to be assured of the safety and effectiveness of these new preparations before substituting them for the standard remedies which have proved their worth under practical conditions. The worth-while developments in insecticides and fungicides are practically invariably the result of study by trained investigators, and the easy and simple control methods which frequently appeal to the consumers are often advocated without a sufficient attempt to demonstrate the real value of the treatment. Real progressiveness is desirable and valuable, but the hasty conclusion which abandons the old remedy for the new may too often result in great loss.

There is still a large field for improvement in control methods, and there are many losses being sustained by damage from insects and diseases, but improvement can be looked for through the efforts of the scientific investigators rather than through the discoveries of the promoters of new theories of control who have not the proper basis or training for demonstrating their theories through carefully conducted experiments.

## INTERSTATE SAMPLES.

During the fiscal year the board reported to the solicitor of the department 71 cases presenting alleged violations of law, with recommendations that the facts be transmitted to the Attorney General to institute criminal action or seizure proceedings. Disposition was made of 221 cases by correspondence with the manufacturers. These cases presented violations which were technical only, not flagrant, or cases in which the manufacturer gave reasonable and adequate explanation of his failure to conform to the provisions of the act. Action was taken to place in abeyance 693 samples which upon examination and test were shown to be in compliance with the provisions of the law or were from shipments of the same goods made prior to shipments for which the manufacturer had been convicted and had after citation conformed to the requirements of the law. On June 30, 1923, 91 cases were pending preliminary hearings or before the board for final action, 107 were held in temporary abeyance pending the receipt of further information or the outcome of prosecution

based on the same product or correspondence with the manufacturers, and 791 samples were undergoing analysis and test.

The inspectors and sample collectors of the board operating throughout the United States collected 1,236 samples during the year. A general classification of the articles represented in the collection is as follows:

*Interstate samples collected.*

| Class of samples. | Number of samples. |
|---|---|
| Arsenate of calcium | 33 |
| Arsenate of lead | 80 |
| Bordeaux mixture and combinations of Bordeaux mixture with insecticides | 51 |
| Chlorinated lime | 10 |
| Dips for animals | 69 |
| Disinfectants, germicides, bactericides | 174 |
| Fly preparations for animals | 59 |
| Fish-oil and whale-oil preparations | 10 |
| Formaldehyde preparations | 38 |
| Insect preparations, household use | 202 |
| Miscellaneous insecticide and fungicide preparations | 169 |
| Kerosene emulsions | 3 |
| Lice and mite killers | 58 |
| Lime-sulphur solution and sulphur preparations | 68 |
| Nicotine preparations | 34 |
| Paris green | 31 |
| Pyrethrum and hellebore powders | 92 |
| Miscellaneous | 55 |
| | 1,236 |

## IMPORT SAMPLES.

During the year 181 official and unofficial import samples of insecticides and fungicides were collected through the various port laboratories of the Bureau of Chemistry for examination and test by the board. Disposition was made of 169 samples. Eleven official samples were found adulterated and misbranded, and it was recommended that the consignments be refused entry until correctly labeled. The remaining samples were unofficial, 9 of them being found to be adulterated or misbranded, or both, and in these cases it was recommended that future shipments be detained, while 145 were neither adulterated nor misbranded. Four official samples were found to be neither adulterated nor misbranded and the shipments were released.

## SPECIAL INVESTIGATIONS.

The routine work necessary in analyzing and testing the official samples collected during the year by the board's inspectors has required so much of the time of the scientists of the board that little time has remained to pursue special investigations for the determination of basic scientific facts necessary in the enforcement of the insecticide act. Therefore, little work has been done along this line, the work on most of the special investigations remaining at very much the same point as when reported upon a year ago.

As time permitted during the year studies of the preparation, composition, and properties of certain arsenates of calcium were continued. Some further work was performed in the preparation

of a paper which will be entitled "The Arsenates of Calcium, II, Equilibrium in the System Arsenic Pentoxide, Calcium Oxide, and Water at 35° (Basic Section)." This paper will not be offered for publication until certain check work can be performed.

The investigations started about two years ago to determine the active principles of two species of larkspur seeds (*Delphinium consolida* and *D. staphisagria*) have been continued. A method of extracting and separating the oils and alkaloids on a considerable scale has been developed, and considerable quantities of oil (free from alkaloids) and of alkaloids have been separated. The oil is now being tested against various species of insects and the chemical and physical properties of the alkaloids are being investigated.

The investigation begun some three years ago to determine what changes commercial samples of calcium arsenate undergo during storage has been completed and the results published as Department of Agriculture Bulletin No. 1115, entitled "Chemical Changes in Calcium Arsenate During Storage."

The study inaugurated some years ago to determine the rate of loss of nicotine in potash-nicotine and soda-nicotine soaps and in papers impregnated with nicotine and to determine the effect of different types of containers on the rate of nicotine loss, the conditions under which loss does and does not occur, and the conditions that will prevent loss has been completed from the chemical point of view. The results have been collated and studied and are now being prepared for publication, if publication appears to be expedient.

The study started about three years ago in regard to changes on storage of commercial nicotine solutions, packed in different types of containers, and nicotine dusts, using various carriers and packed in different types of containers, has been continued throughout the year. This work will be continued until definite conclusions can be drawn that will enable the board to handle cases involving shortages in nicotine in nicotine solutions and nicotine filler dusts.

It is often necessary to know the possible and probable rates at which samples of chlorinated lime lose available chlorine in order to be able to successfully prosecute cases based on shortage of available chlorine in commercial samples of chlorinated lime. In 1921 samples of most of the commercial brands of chlorinated lime sold on the market were placed in storage and the changes in composition studied from time to time. During the past year samples of known origin have been packed under commercial conditions by board chemists and the changes taking place in such samples with lapse of time are being studied. The data on this subject will be offered for publication as soon as it is completed.

Department of Agriculture Bulletin No. 795, entitled "The Adulteration of Insect Powder with Powdered Daisy Flowers," has been revised and reprinted.

The plant pathologists of the board have continued investigations to determine more definitely the amount of active ingredients necessary and safe for some of the more important types of fungicides. This has included work principally on the various sulphur and copper fungicides. In some sections lime-sulphur solution, used at standard strengths for the midsummer application on apples,

has caused objectionable injury, and various methods of avoiding this have been recommended. We have therefore attempted to determine whether the recommendations for a weaker dilution for these applications might be permissible, and whether other less injurious fungicides might efficiently be substituted in part for the lime-sulphur solution at this time. In this connection special tests are being made of the efficiency of the so-called " dry mix," a mixture of sulphur, lime, and casein spreader, combined with an arsenical where necessary. Studies are also being made of the efficiency and possible benefit from the addition of various casein spreaders and stickers found on the market as compared to the several standard types of fungicides.

For the guidance of the board in passing on directions given in labels, an investigation is being made to determine what fungicides may or may not safely be combined with calcium arsenate, and also to determine the effect of this combination on the efficiency of the fungicides as compared with their combination with lead arsenate.

Investigation of the fungicidal value of various dusting mixtures, and also of the dry lime-sulphur products as compared with the liquid, are being continued.

The work on the effects of proprietary preparations and various miscellaneous materials on the chicken mite has been completed and submitted for publication.

Tests with the dry substitutes for liquid lime-sulphur for San Jose scale have been practically completed.

The investigations of dusting mixtures containing various contact insecticides have been continued, but the great variations due to the different types now on the market have rendered the drawing of general conclusions very difficult. It is planned to carry on this work very extensively during the summer of 1924.

Special attention has been given to the value of hypochlorite solutions, chlorinated lime, and the ordinary coal-tar disinfectant as remedies against house flies, and considerable progress has been made in this investigation.

The scientific workers of the Bureau of Animal Industry branch of the board have made investigations to determine the active ingredients of sabadilla seed. A series of tests has been made to determine the penetration of certain insecticides into the skin of animals. Investigations have been made upon capsules of carbon tetrachloride taken from lots from which capsules had been used on foxes as anthelmintics and which were thought to have caused the death of many valuable animals. Investigations have been started to find out how to differentiate between certain hydrocarbons normally appearing in low-temperature coal-tar creosote and similar hydrocarbons appearing in petroleum. The efficiency of these hydrocarbons as insecticides is under investigation.

# REPORT OF THE PACKERS AND STOCKYARDS ADMINISTRATION.

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UNITED STATES DEPARTMENT OF AGRICULTURE,
PACKERS AND STOCKYARDS ADMINISTRATION,
*Washington, D. C., September 10, 1923.*

SIR: I submit herewith the second annual report of the Packers and Stockyards Administration.

Respectfully,

CHESTER MORRILL,
*Assistant to the Secretary.*

Hon. H. C. WALLACE,
*Secretary of Agriculture.*

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This is the second annual report of the Packers and Stockyards Administration, but it is the first report that covers a full year's activities, as the packers and stockyards act had not been in effect an entire fiscal year at the time the first annual report was issued.

In the first report brief reference was made to the importance of the industry affected by the packers and stockyards act, the general causes leading up to its enactment, and the general nature of the authority provided in the act. A general outline of the organization and plans for the administration of the act was given, including also a brief résumé of the chief activities engaged in during that part of the fiscal year in which the administration had functioned.

During this first complete fiscal year in the development of the Packers and Stockyards Administration permanent progress has been made both in connection with the development of the organization itself and in determining the definite course that the work of the administration must necessarily follow; also the proportions the work is apt to assume have been indicated to a fairly definite degree.

The constructive and helpful administration of regulatory statutes assigned to it has always been the aim of the Department of Agriculture. This often is not an easy task, both by reason of its inherent difficulties and scarcity of available personnel, or opposition to a law, and other conditions. It calls for something more than the holding of hearings, the issuance of complaints, the prosecution of litigation, and the entering of orders. In fact, it demands thorough and continued study, which involves fair-minded and competent investigations within the industry on both its practical and theoretical sides.

Such procedure makes law enforcement an intelligent, reasonable operation ultimately commanding the confidence of those whose conduct it affects. Constant care and due determination to represent

without partiality not the interests of any class, stratum, or area, but those of the Nation as a whole can be exercised to the full extent only when the Government is in possession of full and exact facts as to the inside working of an industry placed under its supervision by reason of the fact that it is stamped profoundly with the public interest.

That Congress realized the importance of complete and accurate information to guide law enforcement is indicated by the fact that in passing the packers and stockyards act it conferred upon the Secretary of Agriculture the full powers of investigation into the packing industry theretofore lodged in the Federal Trade Commission. A wide variety of economic, legal, and other questions have arisen during the year, connected directly and indirectly with the administration of the law; hence, the duties imposed have been carried out in many directions. It has been the constant aim to bring the administration of the law as close as possible in a practical way to the markets and the people engaged in the industry.

As was indicated in the first report, a need was recognized for the utmost flexibility in organization arrangements. Therefore, the work of every branch has been carried on with full cognizance of the activities of the other branches, and while the work has not been separated into projects, it has been arranged as a matter of convenience in the assignment of duties, and, for the purpose of this report, into divisions as outlined below, in connection with which the personnel of the various divisions of the work is also given. This general divisional outline follows:

(1) Administration:
Stephen Bray, specialist in marketing livestock and meats, general assistant.
George T. Ash, chief clerk.
(2) Rates, Charges, and Registration:
G. N. Dagger, agricultural economist, in charge.
C. E. Miles, examiner, assistant.
(3) Trade Practices:
Howard M. Gore, specialist in marketing livestock, in charge.
(4) Audits and Accounts:
Arthur S. French, general auditor, in charge.
William E. Fink, senior accountant, assistant.
(5) Economics:
Charles J. Brand, consulting specialist in marketing, in charge.
(6) Law:
Bayard T. Hainer, attorney, in charge.
Lyman S. Hulbert, examiner, assistant.

The work of the various divisions is discussed under these headings.

## ADMINISTRATION.

It is not considered necessary to repeat or discuss in this report the personnel and routine phases of the work that composes the usual administrative activities of the organization, but brief reference is made to one or two special features, as follows:

For convenience in handling administrative matters with respect to livestock market supervision, the United States has been arranged into four geographical divisions, which are subdivided into districts. Each division is under the supervision of a division super-

visor who exercises general supervision over the work of district supervisors and their assistants. The division supervisors are James Christensen, at Denver, for the western division; Dr. F. W. Miller, at Kansas City, for the central division; and W. A. Williams, at Chicago, for the northern division; the eastern division being handled from Washington. The district (local) supervisors have their headquarters at the following markets and visit all other markets at frequent intervals:

| | | |
|---|---|---|
| Buffalo, N. Y. | Kansas City, Mo. | Omaha, Nebr. |
| Chicago, Ill. | Los Angeles, Calif. | Pittsburgh, Pa. |
| Cincinnati, Ohio. | Nashville, Tenn. | Sioux City, Iowa. |
| Denver, Colo. | National Stock Yards, Ill. | South St. Paul, Minn. |
| Fort Worth, Tex. | New York, N. Y. | South St. Joseph, Mo. |
| Indianapolis, Ind. | North Portland, Oreg. | Washington, D. C. |

In this way the Washington general office is relieved of much detail work which otherwise it would have to handle. Furthermore, the administrative work, both general and special, is reflected throughout the work of all the divisions which will be discussed under separate chapters.

The supervisors are the points of contact of the administration with the various agencies operating in the public stockyard markets. It is their duty to acquaint themselves with all phases of the operations and personnel of the markets under their supervision, to be watchful for conditions that may adversely affect marketing conditions and the interests of shippers and others who patronize the markets, and to secure adjustments through informal action, whenever possible, of complaints that they may receive. They are not confined to purely regulatory activities, but render helpful service in any way that may appear desirable. For example, during the period of serious car shortage in the fall of 1922 they rendered every service possible to shippers and market agencies and kept in close touch with the railroads and with supervisors at other markets, together with the Washington office, which in turn handled such matters with the Interstate Commerce Commission and the American Railway Association. Under normal conditions they have assisted in securing improved train service and other facilities for handling livestock to and from the stockyards, and they have not hesitated to place themselves at the service of shippers and market agencies in any way that would better their markets.

In the report of Col. Henry W. Anderson, trustee under what is known as the "packer consent decree," made under date of March 21, 1923, to the Supreme Court of the District of Columbia, is found the following with reference to the packers and stockyards act:

> Its effect has been beneficial, especially upon the relations between the public and the stockyards companies, in that it had provided at each of the yards an authorized representative of the Department of Agriculture, to whom any person having complaints on any matter arising on the yards could present such complaints for adjustment. It was the general testimony of the management of these yards that the supervisors appointed by the Department of Agriculture had been useful in the adjustment of such questions and in bringing to the attention of the management any matter which might be the subject of complaint which had escaped their attention, and that the presence of these supervisors and the knowledge that the yards were under the general supervision of the Department of Agriculture had tended to satisfy the public, to remove irritation and complaint.

It will no doubt be of interest to state here the general plan that is followed in keeping the members of the organization and the public advised concerning the activities of the Packers and Stockyards Administration. This is done through the issuance to members of the organization of a confidential weekly summary of its activities, and through the issuance to the public of a monthly summary of the activities engaged in by the various supervisors and officials of the administration, through the issuance of press items from the department's press service, through public addresses made by members of the staff and supervisors as occasion requires, and through conferences and general correspondence conducted in the usual way.

One other feature of the Washington part of the work may be mentioned. The Assistant to the Secretary, in charge of the Packers and Stockyards Administration, is also the head of the Grain Futures Administration. Although the affairs of the two organizations are entirely separate and distinct and could be separated physically at any time, a very economical administration in the Washington office has been effected through single direction. In addition to the officer in charge and his secretary, the chief clerk and the clerical force in Washington constitute a joint organization and a single set of offices is used for both. Every possible duplication of personnel or expense has been avoided, and the saving in salaries and other administrative expenses is substantial.

## RATES, CHARGES, AND REGISTRATIONS.

During the year there have been about 400 cancellations of registrations, and at the same time there has been a constant stream of new registrations coming to this division for which certificates were issued. At the close of the year there were registered with the Packers and Stockyards Administration 4,002 dealers and 1,169 market agencies. In this work the market supervisors assisted very greatly.

In order to provide an adequate filing system a complete alphabetical file of registrants was prepared in addition to the numerical file and the market file. This required the keeping of card records for each registrant, so that quick reference can be had to the facts concerning any registrant.

The stockyards located at Dublin, Ga., and Birmingham, Ala., were dismissed from the jurisdiction of the Packers and Stockyards Administration during this fiscal year by orders of the Secretary of Agriculture, dated, respectively, June 27 and May 19, 1923. Seven additional yards were brought under the jurisdiction of the Packers and Stockyards Administration during this period. These yards are: Western Stockyards, Amarillo, Tex.; Pursley Stockyards, Chattanooga, Tenn.; Union Stockyards, Dallas, Tex.; Fort Wayne Union Stockyards, Fort Wayne, Ind.; Union Stockyards, Laredo, Tex.; Los Angeles Union Stockyards, Los Angeles, Calif.; and the Union Stockyards, Roanoke, Va.

A list of stockyards subject to the jurisdiction of the Packers and Stockyards Administration at the close of the fiscal year follows:

| Name of yard. | City. | Date posted. |
|---|---|---|
| Western Stockyards Co | Amarillo, Tex | July 1,192 2 |
| New Orleans Stock Yards (Inc.) | Arabi, La | Nov. 1,1921 |
| Miller Union Stock Yards | Atlanta, Ga | Do. |
| J. W. Patterson Commission Co | do | Apr. 1,1922 |
| Suttles, Bragg & Millsaps | do | Do. |
| Augusta Stock Yard Co | Augusta, Ga | Nov. 1,1921 |
| Union Stock Yard Co | Baltimore, Md | Do. |
| Union Stock Yard Co. of New Jersey | Benning, D. C | Do. |
| Brighton Stock Yards Co | Brighton, Mass | Do. |
| The Buffalo Stock Yards | Buffalo, N. Y | Do. |
| Foust-Yarnell Stock Yards | Chattanooga, Tenn | Do. |
| Pursley Stock Yards | do | July 1,1922 |
| Union Stock Yard & Transit Co. of Chicago | Chicago, Ill | Nov. 1,1921 |
| Cincinnati Union Stock Yard Co | Cincinnati, Ohio | Do. |
| Cleveland Union Stock Yards Co | Cleveland, Ohio | Do. |
| Columbia Stock Yards | Columbia, S. C | Do. |
| Drovers Union Stock Yards | Columbus, Ohio | Do. |
| Dallas Union Stock Yards Co | Dallas, Tex | July 1,1922 |
| Union Stock Yards Co | Dayton, Ohio | Nov. 1,1921 |
| Denver Union Stock Yard Co | Denver, Colo | Do. |
| The Detroit Stock Yards | Detroit, Mich | Do. |
| El Paso Union Stock Yards Co | El Paso, Tex | Do. |
| Independent Stock Yards | do | Do. |
| Evansville Union Stock Yards Co | Evansville, Ind | Do. |
| Fort Wayne Union Stock Yards Co | Fort Wayne, Ind | July 1,1922 |
| Fort Worth Stock Yards Co | Fort Worth, Tex | Nov. 1,1921 |
| Fostoria Union Stock Yards Co | Fostoria, Ohio | Do. |
| Belt Railroad and Stock Yards Co | Indianapolis, Ind | Do. |
| National Stock Yards | Jacksonville, Fla | Do. |
| The Jersey City Stock Yards Co | Jersey City, N. J | Do. |
| Kansas City Stock Yards Co | Kansas City, Mo | Do. |
| East Tennessee Stock Yards | Knoxville, Tenn | Do. |
| Lafayette Union Stock Yard Co | Lafayette, Ind | Do. |
| Union Stock Yard Co | Lancaster, Pa | Do. |
| Laredo Union Stock Yards | Laredo, Tex | Dec. 1,1922 |
| Los Angeles Union Stock Yards Co | Los Angeles, Calif | Nov. 1,1922 |
| Bourbon Stock Yard Co | Louisville, Ky | Nov. 1,1921 |
| Marion Union Stock Yards Co | Marion, Ohio | Do. |
| Memphis Union Stock Yards | Memphis, Tenn | Do. |
| Dixie National Stock Yards (Inc.) | do | Do. |
| South Memphis Stock Yards | do | Do. |
| Milwaukee Stock Yards Co | Milwaukee, Wis | Do. |
| Union Stock Yards Co. of Montgomery (Inc.) | Montgomery, Ala | Do. |
| Moultrie Stock Yards | Moultrie, Ga | Do. |
| Nashville Union Stock Yards (Inc.) | Nashville, Tenn | Do. |
| St. Louis National Stock Yards | National Stock Yards, Ill | Nov. 1,1921 |
| Newark Stock Yards | Newark, N. J | Do. |
| New York Stock Yards Co | New York, N. Y | Do. |
| Union Stock Yards Co | Norfolk, Va | May 1,1922 |
| Portland Union Stock Yards Co | North Portland, Oreg | Nov. 1,1921 |
| Salt Lake Union Stock Yards | North Salt Lake, Utah | Nov. 1,1921 |
| Union Stock Yards | Ogden, Utah | Do. |
| Oklahoma National Stock Yards Co | Oklahoma City, Okla | Do. |
| Pasco Union Stock Yards Co | Pasco, Wash | Do. |
| Peoria Union Stock Yards Co. (Inc.) | Peoria, Ill | Do. |
| West Philadelphia Stock Yard Co | Philadelphia, Pa | Do. |
| Pittsburgh Union Stock Yards Co | Pittsburgh, Pa | Do. |
| Pueblo Stock Yards Co | Pueblo, Colo | Mar. 1,1922 |
| Richmond Union Stock Yards Co | Richmond, Va | Oct. 31,1921 |
| Southern Stock Yards Corporation | do | Do. |
| Union Stock Yards Corporation | Roanoke, Va | Mar. 15,1923 |
| Union Stock Yards, S. A | San Antonio, Tex | Nov. 1,1921 |
| Union Stock Yards Co. of Seattle | Seattle, Wash | Do. |
| Sioux City Stock Yards Co | Sioux City, Iowa | Do. |
| Sioux Falls Stock Yards Co | Sioux Falls, S. Dak | Do. |
| Union Stockyards Co. of Omaha (Ltd.) | South Omaha, Nebr | Do. |
| St. Joseph Stock Yards Co | South St. Joseph, Mo | Do. |
| St. Paul Union Stockyards Co | South St. Paul, Minn | Do. |
| Spokane Union Stock Yards Co | Spokane, Wash | Do. |
| Springfield Union Stock Yards Co | Springfield, Ohio | Do. |
| Inter-State Stock Yards Co | Toledo, Ohio | Do. |
| Toledo Union Stock Yards Co | do | Do. |
| Wichita Union Stock Yards Co | Wichita, Kans | Do. |
| New York Central Stock Yards | West Albany, N. Y | Do. |

During the fiscal year 21 additional stockyards have been investigated, and from the reports it appeared that they did not come under the definition of the term "stockyards," as provided in the packers and stockyards act. These yards are located at Caliente. N. Mex.;

Las Vegas, N. Mex.; Phoenix, Ariz.; Houston, Tex.; Huron, S. Dak.; Hutchinson, Kans.; Kearney, Nebr.; Lexington, Ky.; Manhattan, Kans.; Memphis, Tenn.; Muncie, Ind.; Salina, Kans.; San Francisco, Calif.; Shreveport, La.; Topeka, Kans.; Valdosta, Ga.; Boston, Mass.; and Winchester, Ind.

### SCHEDULES OF RATES AND CHARGES.

During the first part of the year an effort was made to have every market agency and stockyard company file five copies of its schedules of rates and charges. This was accomplished through the cooperation of the market supervisors. In checking up it was found that many agencies had been improperly registered and others had registered more than once. After the schedules were all obtained, folders were prepared for each market agency, so that there is now on file a complete history of the schedules for each market agency and stockyard company, as well as a file of effective tariffs, a file for the use of the division of audits and accounts, and a file for working purposes of this division.

One compilation for all stockyards companies and another for all commission agencies have been prepared and distributed, showing all their rates and charges for all the markets.

There have been many changes in schedules during the year. In each case where these changes and proposed changes have involved increases in rates they have been investigated carefully in order to determine whether the increases should be allowed. The market agency or stockyard company proposing changes has been called upon to furnish specific information, and the auditing division of the Packers and Stockyards Administration has secured further information when necessary. In many cases where it appeared that the increases were not justified, it was possible to adjust the matter satisfactorily without the necessity of formal proceedings. In a number of cases the proposed increases were withdrawn after full information had been presented and considered. A number of formal proceedings were begun and carried on, information regarding which, including the arbitration of commission rates, will be found in the part of this report devoted to the docket record.

### PATRONAGE DIVIDENDS BY COOPERATIVE ASSOCIATIONS.

From time to time during the administration of the packers and stockyards act questions have been raised under paragraph (*f*) of section 306 with respect to the payment of patronage dividends by cooperative associations of producers. The Packers and Stockyards Administration has dealt with each organization according to the facts submitted in connection with its plan of operation, with proper regard to the laws of the State under which the association was incorporated, and has published no general rulings or opinions. The administration, however, uniformly advised all associations interested that section 306 (*f*) of the packers and stockyards act makes it unlawful for any market agency to "refund or remit in any manner any portion of the rates or charges" specified in its published schedules, but that it expressly provides that "this shall not prohibit a cooperative association of producers from bone fide returning to its members on a patronage basis its excess earnings on their live-

stock." The act also prohibits any market agency from extending to any person at the stockyards where it is engaged in business any stockyard services except such as are specified in its published schedules. The general rules and regulations of the Secretary of Agriculture require that each market agency that is a cooperative association of producers shall expressly so state in its schedule, and shall also plainly state the method of distribution or apportionment of its excess earnings or deficit, if any. It will be understood that every market agency, whether cooperative or otherwise, in filing its original schedule is entirely free to determine for itself what its rates and charges shall be, and subsequently thereto it may change the same upon 10 days' notice, subject to the conditions stated in the statute.

A cooperative association of producers is an association composed of and controlled by producers in which each of the members has a voice in the affairs of the organization and the right to vote. Membership in an association must carry with it rights and responsibilities with respect to the management, control, operation, and maintenance of the organization. In determining who are the members of an association the foregoing facts should be borne in mind.

It is clearly unlawful for a cooperative association to pay patronage dividends to nonmembers. It is manifest that in order for a cooperative association to come within the provisions of the act relating to patronage dividends—

(*a*) The market agency must be a cooperative association of producers;

(*b*) Its refunds to shippers of livestock must be bona fide returns to its actual members only;

(*c*) Such returns must be on a patronage basis;

(*d*) The association must not make such returns to nonmembers.

A person is not a member of an association unless he has agreed to assume the obligations of membership, including both the responsibilities and privileges attaching thereto, and has been accepted by the association as a member. A mere declaration by a cooperative association that certain individuals or a group of producers are members of the association, without recognition and acceptance of both the obligations and privileges of membership by such individuals or group, does not make such individuals or group of producers members, and hence they are not members under the packers and stockyards act with respect to the determination of who are members for the purpose of paying patronage dividends. Membership may be acquired and dividends distributed either by direct contact between the terminal market agency and the individual shipper or indirectly through the medium of his local cooperative shipping association, if it has the requisite authority.

### VALUATION WORK.

In attempting to determine the reasonableness of stockyard charges, it is necessary to collect information concerning the value of stockyard property. Prices of materials have been compiled and forms necessary in inventory and appraisal work have been prepared. The appraisal of the Peoria Union Stockyards has been checked, and an appraisal by the engineer of the Packers and Stockyards Administration has been presented at a public hearing; also, an appraisal has been made of the feeding facilities at the Omaha stock-

yards and the Pittsburgh stockyards. An inventory and appraisal of the Chicago Union Stockyards is under way. The importance and responsibility of such an appraisal is indicated by the fact that the valuation claimed by the stockyards company is approximately $33,000,000. In addition, an inspection has been made of several yards for the purpose of determining the time necessary for making an appraisal. Herman C. Henrici, of Kansas City, an engineer of high standing and wide experience in construction and valuation work, and A. T. Cushing, formerly of the forces of the Interstate Commerce Commission engaged in railroad valuation work, were employed by this division during the fiscal year to handle its valuation problems.

### OTHER ACTIVITIES.

This division has looked after the filing of all contracts of stockyard companies, the organization papers of cooperative commission companies, and the rules of livestock exchanges.

It has been found necessary to correlate and analyze a large amount of data which have come to this division from the division of audits and accounts, from special reports and from investigations and hearings conducted at the various markets concerned, in connection with the determination of the commission and stockyard rate cases. No rule of thumb can be applied to such matters. A patient study has been made in each case as it has arisen of all the practical conditions surrounding the application of the rates and charges, the statistical and auditing material, and the legal aspects, together with the probable effect of any decision that might be reached not only in the market involved but in other markets if similar questions should arise.

In this connection, it is pertinent to observe that the jurisdiction and problems of this division are comparable in a substantial way with those under the interstate commerce act, from which much of the packers and stockyards act is drawn in respect to matters of rates and charges.

## TRADE PRACTICES.

This division handles apparent violations of the packers and stockyards act or the rules and regulations involving the trading conduct or methods of any person subject to the act. Therefore, it has direct contact with practically all phases of the industry.

Proceeding in accordance with the general policy of the administration to act informally whenever it is possible to get desired results by doing so, the division of trade practices has handled numerous cases in this manner to a satisfactory conclusion without the necessity of resorting to formal proceedings, thus avoiding not only delay and expense but the antagonistic feeling which often results from formal proceedings. The cases of this character that have received attention cover a wide variety of market practices and are distributed quite extensively throughout the field of marketing activities. In all cases, however, appropriate action is taken as promptly as practicable with the main purpose in view of establishing satisfactory trading conditions at all the markets and strict adherence by all persons concerned to an effort to maintain the open-market principle on a basis of fair dealing and clean competition.

The activities of the market supervisors in the field consist largely of matters that come under this division and many of the accomplishments reported as constituting a part of the work of this division have been results of activities by division or district supervisors.

Work of this division covered by formal proceedings will be found described in the portion of this report devoted to the docket proceedings.

### STATE REGULATIONS.

One of the serious problems which required special attention in the early part of the fiscal year involved a situation that started in the latter part of the previous fiscal year with reference to certain statutes of the State of Minnesota passed prior to the enactment of the packers and stockyards act, which vested in the railroad and warehouse commission of that State authority to supervise the marketing activities at stockyards. This matter was raised through complaints submitted on behalf of shippers outside of Minnesota, with reference to the imposition of a certain charge per head by the State for weighing livestock in the market.

An opinion was rendered by the attorney for the Packers and Stockyards Administration to the effect that the packers and stockyards act, 1921, superseded the State law. This opinion was upheld by the Attorney General of the United States, but was questioned by the State until it could be passed upon by the Supreme Court of the United States. In the meantime litigation in the State and Federal courts was instituted between the stockyards company, the commission men, and the State. An arrangement was entered into during August, 1922, whereby the weighing service would continue to be performed by the State weighers, but the stockyards company assumed the expense without extra cost to patrons of the market, saving them about $70,000 a year. This arrangement, which became effective August 15, 1922, was brought about through the efforts of the Packers and Stockyards Administration. A memorandum of understanding was drawn up and signed by representatives of the Department of Agriculture, the State Railroad and Warehouse Commission of Minnesota, and the St. Paul Union Stockyards Co., setting forth definitely the conditions under which the weighing of livestock should be performed during the period of this arrangement and recognizing the supervisory authority of the Secretary of Agriculture.

The St. Paul Union Stockyards Co. and the State Railroad and Warehouse Commission agreed that the St. Paul Union Stockyards Co. would pay the wages of certain State employees connected with the weighing and other expenses incidental thereto for a period of one year from the effective date of the agreement, during which time it was agreed that all litigation involving the State and Federal authority in connection with this whole matter would be expedited by the parties in every reasonable way in order that the whole controversy might be settled finally. Final settlement had not been reached at the close of the fiscal year, although the attention of all parties had been directed during the latter part of the year to the approaching expiration of the agreement; but this temporary adjustment had the effect of preventing injurious interruption to the marketing process at the St. Paul market.

### OPEN MARKET.

The matter of placing on the open market all livestock consigned for sale has been given special attention during the fiscal year, with satisfactory results, by following up actual conditions wherein it appeared that the open-market principle had been violated.

Attention was given to the question of discrimination which has grown out of the establishment of cooperative selling agencies at some of the principal markets, and a feeling on the part of some of the old-line commission agencies that the best way to fight this form of competition was to permit no dealings with the cooperative agencies. A general understanding is now prevalent among all agencies at the markets that open-market principles must prevail and that no discrimination in this respect will be countenanced.

### HANDLING STOCK.

Special attention has been given to the loading and unloading of livestock at various markets, especially with reference to the handling of crippled stock, and noticeable improvement has been brought about which has resulted in corresponding benefits to owners and shippers. In this connection an extensive study was made during the early part of the year by supervisors of stock bruised during the loading and unloading process, which study included strict observation of the various causes resulting in bruises and the extent to which injury could be prevented. As a result of this investigation reports from supervisors clearly indicate that this condition has greatly improved during the year, which means not only a saving to livestock producers, owners, and shippers, but also an important economic saving to the industry as a whole.

### PRICES FOR REACTORS, BRUISED, CRIPPLED, AND DEAD ANIMALS.

Considerable effort has been given to the matter of prices paid for the classes of stock mentioned above. The fact that these classes of animals necessarily require special attention and handling renders them more subject to different kinds of irregularities than if they could be handled in the regular way, especially with reference to prices paid for them at the market. It should be understood, however, that such irregularities were not found to be practiced as a general proposition or to be intentional in all the instances where they prevailed, but were in a large measure the outgrowth of custom or the rush necessarily resulting from the fact that livestock is a perishable commodity and must be marketed as such. It was found, however, that there were many places wherein the system under which these classes of animals were handled through the market, with a little special attention, could be and was improved, greatly to the advantage of the producers and owners affected. Through these methods the prices paid for dead animals at a number of markets were materially advanced. The Packers and Stockyards Administration has continued its cooperation with the Bureau of Animal Industry, described in the first annual report, in an effort to bring about conditions whereby prices of reactor cattle will be maintained more in keeping with the value of the different animals.

### PRICES STAMPED ON SCALE TICKETS.

The question has been raised at different times whether it would not be advisable for the price at which livestock is sold to be stamped on the scale ticket at all markets. The merits of this plan have been carefully studied by the administration, and at one important market the members of the trade, including the stockyard company, have cooperated with the administration by putting the plan into effect in order to determine its merits. At the close of the fiscal year the plan seemed to be working satisfactorily at this market and had produced practical benefits.

### FRAUDULENT PRACTICES.

At a leading market the audit disclosed proof that one firm had withheld portions of the moneys due three cooperative shipping associations. This information was imparted to officials of the exchange of which the firm was a member. This giving of such information to the exchange had previously been authorized by the members. A few days later the firm in question agreed in writing to repay with interest the sums wrongfully withheld from cooperative shipping associations and to dissolve its organization and discontinue its business in the local commission field. Cases of this kind result in prompt and effective action.

An attempt to continue to describe in detail the activities of the Packers and Stockyards Administration in all markets would lengthen this report to such an extent as to be burdensome; but as there has been a considerable amount of discussion of the work of the administration in the South St. Paul market, it is believed that a brief statement of the results growing out of the audit of the books of the commission agencies in that market will serve to illustrate the manner in which the policies of the administration are carried out.

A force of auditors was sent to the St. Paul market to audit the books of the individual commission agencies. At that time we had a conference with officials of the livestock exchange, which is composed of most of the commission agencies at that market. They expressed their desire to cooperate with us in making the audit and told us that if we found anything wrong on the part of any of their members they wanted to know it, so that they could take disciplinary action as provided for in their rules, and each of the members signed a statement authorizing us to make known to the officials of the exchange any irregularities of which the individual members might be guilty.

Before the auditors had been at work very long they discovered that some of the commission agencies had been engaged in irregular or unfair trade practices. These were of varying seriousness. In most of the transactions involved the market agencies did not derive any direct profit. It appeared that in many cases it was the practice for commission agencies to return out of the net proceeds of shipments a small amount to the manager of a shipping association or the individual who was responsible for handling the proceeds of the shipment. This was the result of an arrangement between the shipping manager and the commission agency under the apparent inducement to the commission agency of holding the business of the shipping association. We have no authority over these local shipping man-

agers, but the investigation of their conduct will be carried on by the State commissioner of agriculture.

These offenses were not confined to any one class of agencies in the market. As soon as their nature appeared, and as they were apparent violations of the exchange rules, the auditors reported them to the board of directors of the exchange. The rules of the live-stock exchange at South St. Paul had been filed with us as required by law, and these rules include the right of the exchange to punish its members for improper conduct. The rules of the stockyards company also have been filed with this department and it has authority to deal with misconduct in the yards. Under the packers and stockyards act both the exchange and the stockyards are required to enforce the rules and regulations which they have filed with us. The exchange can discipline its members either by fines or by suspension or expulsion from membership because its members have agreed to abide by these rules. The stockyards company can exercise the same power over wrongdoers by virtue of its ownership of the yards and can bar agencies from the yards in case of flagrant wrongdoing in order to protect its market place.

Such authority on the part of the exchange and the stockyards company, however, in no way precludes or interferes with the enforcement by the Secretary of Agriculture of any disciplinary authority that he may possess under the packers and stockyards act. There seems to be a misunderstanding as to the authority of the Department of Agriculture. The Secretary of Agriculture has no authority to refuse to register commission agencies doing business on the market. He has no authority directly to put off the market commission agencies which may be found guilty of wrong-doing. The part of the law which gives authority for dealing with irregular practices provides that when such practices are found the offending party shall be notified and, if necessary, a full hearing shall be held; and in case guilt is established, either by admission or through the hearing, the Secretary has authority to issue an order to cease and desist from such wrongdoing. After the order to cease and desist has been issued against any commission agency it becomes subject to a heavy fine for any repetition of the offense. No fine can be imposed for the first offense, except through prosecution in court for such special offenses as rebating or failing to keep required records.

The task of auditing the books of more than 30 commission agencies in this market was a big one. We could have waited until the audit is completed and then cite these agencies to hearings, when if they are found guilty we can issue orders against them to cease and desist. We could not have put them off the market, nor could we have fined them at that time for what they had done. Such a course would have delayed results for several months. A person charged with an offense which may call for an order from the Secretary of Agriculture is entitled to notice and an opportunity to be heard, in keeping with his constitutional rights. On the other hand, it was evident that the members of the exchange had rendered themselves subject to punishment for violation of its rules, and it was evident that they had violated rules of the stockyards company. To get prompt action, therefore, these agencies were at once reported to the exchange.

Action by the exchange and the stockyards company was prompt and drastic. The net result was that 2 firms involved in the irregularities have closed their businesses and withdrawn from the stockyards. Nine firms were fined and 7 other firms were indefinitely barred from the yards. In all, 23 persons connected with 9 commission agencies were barred from the privileges of the St. Paul Union Stockyards. Of these 23 persons, 2 have been permitted to resume business, having shown that they were personally innocent of any guilty knowledge of the transactions disclosed, and 4 others have been permitted to seek employment in the yards, but not to resume business on their own account, not because they had been affirmatively guilty, but because they had not been watchful in protecting the interests of their principals.

Thus it clearly appears that the guilty ones were punished effectively. In addition, every practical step is being taken to secure restitution for shippers if they have lost anything through these irregularities.

It should clearly be understood that the punishment inflicted by the exchange and the stockyards company does not relieve any of the guilty agencies from penalties of the law which may be enforced by the Department of Agriculture. Formal proceedings have been or will be prosecuted by the Department of Agriculture against both members of the exchange and nonmembers in every case where they remain in business in the yards. If they are found guilty, orders to cease and desist will be issued, and thereafter, if the offense is repeated, they will be subject to the fines imposed.

Nothing has been done to relieve the guilty from the full penalties of the law. The punishment imposed by the exchange and stockyards company is not a substitute for action on the part of the Department of Agriculture. This procedure at South St. Paul is in conformity with the policy of the Packers and Stockyards Administration, which has been followed uniformly, of promptly informing the boards of directors of livestock exchanges and cooperative associations of improper or unfair practices on the part of their members or officers, thereby giving such organizations the opportunity to take such action against the individuals responsible as the facts might warrant.

The course that we have followed has resulted in putting the most guilty agencies out of the market and imposing discipline on the others. If we had not cooperated with the livestock exchange and the stockyards by enabling them to perform their duty under the law, punishment would not have been as prompt as it has been; in fact, so far as our authority alone is concerned, the guilty agencies would still be doing business in the yards.

When the investigation and formal proceedings have been completed a detailed report of the entire matter will be made available for publication.

In these and other respects, such as the establishment of separate shippers' proceeds banking accounts, placing the prices on all scale tickets, bonding of all commission agencies, the operation of a representative local trade practice committee, the adjustment of the weighing question, including the elimination of weighing charges, the agreement to arbitrate commission rates, and the settlement of other matters of lesser importance, the circumstances make it fair to say,

without invidious implications so far as other markets not mentioned by name are concerned, that the St. Paul market is placing itself on a high plane from the producers' standpoint.

### PRICE DISCRIMINATION CHARGED AGAINST PACKER BY 29 CREAMERIES.

The Federal Trade Commission transmitted to the Secretary of Agriculture a file of petitions and protests from 29 creameries in the State of Washington, alleging that in the purchase of butterfat one of the large packers was using an unfair method of competition, namely, price discrimination against competitors. As a result of this complaint, an exhaustive investigation was made in detail at all the principal points affected by the complaint, but the investigation disclosed that the charges made in the complaint were not supported, and each of the 29 complainants was advised that the evidence furnished by the complainants, together with the evidence procured by the administration, was insufficient to justify the issuance of a complaint charging a violation of any of the provisions of Title II of the packers and stockyards act.

### TRADE PRACTICES COMMITTEES.

At several of the markets committees have been organized composed of representatives of the various interests at the markets, the functions of which are to consider and devise proper rules or standards of business conduct that all interests should be willing to abide by, to recommend constructive action to local authorities, and to lend such assistance to local authorities, organizations, and the Federal Government in carrying out these standards as it can. As an example of the personnel of these committees, it may be noted that at one market the following factors are represented thereon: The livestock exchange, the traders' exchange, the cooperative livestock selling agencies, the stockyards company, the packers, and the livestock market supervisor.

As may be seen from the above reference to the duties of this committee, while it does not administer discipline, such committees are in a position to render valuable service to the industry.

### SCALES AND WEIGHING.

On account of the importance of weighing in the marketing of livestock, special attention is being given to the accuracy of scales and the integrity of weights obtained, and in order that the administration may give this important phase of marketing the kind of attention it merits, a livestock weight supervisor was appointed early in this fiscal year, whose duty is to give special attention to the matter of scales and weighing. C. A. Briggs, formerly with the Federal Bureau of Standards, was appointed for this work because of his special qualifications as an engineer having technical knowledge of and experience with heavy-duty scales and related matters.

In many cases certain phases of the business appear to have been largely affected by the unsuitable nature of the scales used and the irregularities in the methods of weighing. Irrespective of the merits of their attitudes, it is reasonably certain that some who have built up their business, and who have become accustomed to the benefits from irregular practices, will seriously contest anything which will bring about a change.

A matter which has already introduced a difficulty is that the information which is often furnished about scales is unreliable. It is not always possible to get an idea of the actual condition of scales from the statements made about them, or from the reports of the tests of scales. Frequently the inferences to be drawn from the reports and from statements are that the scales are in an entirely satisfactory condition, but an investigation shows that this is not the case. Trouble from such sources will in course of time be eliminated, but uniform methods and standards must be realized first.

A general survey of the whole situation has been made and steps have already been taken to safeguard the methods of weighing and the facilities thereon. This has been done by the preparation of weighing instructions which outline the duties and responsibilities of weighmasters and the practices which they should follow in using a scale. These have been drafted and issued in preliminary form to determine what provision is necessary properly to cover the subject, and to determine the extent and character of the criticisms which can be raised against them. Up to the present time no important criticisms or objections, other than calling for slight amplifications of the matter presented, have been made.

In order to acquaint our market supervisors with the requirements for correct weighing and put them in a position to be of as much help in realizing accuracy in livestock weights as is practicable, and in order that accurate weights be realized at a minimum of expense and organization, a series of articles dealing with various phases of livestock weighing have been prepared and issued in the weekly summaries and sent to our market supervisors. These articles have touched upon different subjects which have arisen from time to time.

The cooperation of stockyards companies has been enlisted and promises to bring about conditions which will increase accuracy in livestock weights.

Scale manufacturers and scale-testing agencies have been given an opportunity to act with us. Plans are being perfected to confer with them and to cooperate closely, so that a full, proper, and effective understanding will be realized in reference to the construction, installation, testing, and maintenance of scales.

In bringing about changes which are necessary, in every case those directly concerned and responsible for the accuracy of the scales are given every opportunity to carry on the work in a satisfactory manner. In following out this policy, so far good results have been obtained.

The attention which has been given to the subject has indicated the more important problems which should receive further attention in reference to livestock weighing, and much practical benefit should result in the following fiscal year.

### MISCELLANEOUS MATTERS.

As an example of the different matters to which the attention of the Packers and Stockyards Administration is given, the following is quoted from a report of one market supervisor:

> All livestock consigned to the market is placed on the open market. String sales are not indulged in on the market.

Weighing up is indulged in to a limited extent, but no carloads are weighed up if satisfactory buyers can be found.

The scales are kept in first-class condition and sufficient in number to serve the requirements. Weighmasters are careful in giving full and correct weights.

Boycotting is an unknown problem here.

Buyers have agreed to pay the same price for reactor cattle as for similar grades of nonreactors.

No yardage charge is made for removing dead carcasses from cars.

Quality of both hay and grain fed at the yards is good.

The management of the stockyards has required all of its employees to discontinue the use of prod poles and has substituted cloth slappers. This has eliminated much abuse. The employees seem to like the slappers.

Rebating, apparently, has been entirely eliminated.

Sanitary conditions are good.

The administration is receiving strong cooperation from the management of the yards, who expressed the opinion that the administration has accomplished much good at this market.

Another supervisor reports:

There are undoubtedly better market conditions at this market than there were 10 months ago. The most gratifying thing to me is that shippers are distinguishing in favor of the market agencies that render the more efficient and satisfactory service. It seems that the better class has taken a very decided stand against questionable practices, and they are being rewarded in their efforts to clean up the market. I have tried to impress upon these people that a reputation for efficiency and squareness is their biggest asset; that a customer who has been badly treated is often a knocker on the market as well as on the commission man who is to blame for the bad treatment; and that the reputation of one man, in a measure, reflects on the entire market. The stockyards company recognizes this and is making an effort to assist in making this a clean market. In my association with shippers I have attempted to give them correct information as to market practices and conditions, and on several occasions have been able to convince a dissatisfied shipper that he was fairly treated and had no cause for complaint. I have attempted to make the men here feel that the Packers and Stockyards Administration would be a useful partner in building up a reputation for honest and efficient service if they would do their part in making it so.

Other practices have been dealt with effectively, to the obvious benefit of the markets concerned, as well as the patrons thereof, such as the practice of trading in livestock by stockyard employees, the elimination through traders' exchanges of traders found to be irresponsible, and features of a similar character.

## AUDITS AND ACCOUNTS.

This division audited and reported on the financial affairs of 465 commission concerns (market agencies) at the 23 markets named below:

| | | |
|---|---|---|
| Arabi, La. (New Orleans). | Fort Worth, Tex. | New York, N. Y. |
| Baltimore, Md. | Indianapolis, Ind. | Oklahoma City, Okla. |
| Buffalo, N. Y. | Jersey City, N. J. | Omaha, Nebr. |
| Chicago, Ill. | Kansas City, Mo. | St. Paul, Minn. |
| Cleveland, Ohio. | Louisville, Ky. | San Antonio, Tex. |
| Denver, Colo. | Milwaukee, Wis. | Sioux City, Iowa. |
| Detroit, Mich. | Nashville, Tenn. | Sioux Falls, S. Dak. |
| | National Stock Yards, Ill. | Wichita, Kans. |

In addition to these audits, quarterly reports on a uniform basis of classification were required as to income and expenses and financial status of all commission agencies at all markets.

Audits were made and completed for the stockyards located in the following 18 markets:

| | | |
|---|---|---|
| Chicago, Ill. | Sioux City, Iowa. | Louisville, Ky. |
| Kansas City, Mo. | St. Joseph, Mo. | Nashville, Tenn. |
| Omaha, Nebr. | Denver, Colo. | Peoria, Ill. |
| National Stock Yards, Ill. | Wichita, Kans. | Seattle, Wash. |
| St. Paul, Minn. | Oklahoma City, Okla. | Pittsburgh, Pa. |
| Fort Worth, Tex. | Baltimore, Md. | Portland, Oreg. |

Audits were in progress but not completed at the close of the fiscal year for the stockyards at the following seven markets:

| | |
|---|---|
| Spokane, Wash. | Buffalo, N. Y. |
| Salt Lake City, Utah. | Detroit, Mich. |
| Ogden, Utah. | Cincinnati, Ohio. |
| Jersey City, N. J. | |

The audits of the stockyard companies named cover the business of two calendar years, namely, 1921 and 1922. The information secured includes consolidated profit and loss statements and analyses of surplus, together with comparative balance sheets. In addition to this, there were obtained detailed profit-and-loss statements on the various services as follows:

| | |
|---|---|
| Yardage. | Loading and unloading. |
| Resale yardage. | Rent. |
| Hay. | Horse market. |
| Corn. | Hotel. |
| Bedding. | Miscellaneous. |

In addition to the information obtained through these audits, financial reports showing income and expenses, balance sheets, etc., were obtained from time to time for all stockyards under the jurisdiction of the packers and stockyards act. The ability of the Packers and Stockyards Administration to deal intelligently with the rates and charges and financial situation of the market agencies and stockyards is rapidly being enhanced by these audits and reports.

Detailed statistical studies were made of the livestock commission business in the following livestock markets:

| | |
|---|---|
| Omaha, Nebr. | Fort Worth, Tex. |
| St. Paul, Minn. | Pittsburgh, Pa. |
| Portland, Oreg. | |

Tabulations were prepared of all receipts of livestock arriving on consignment for sale by commission agencies at the above-listed markets during the calendar year 1921. Some idea of the comprehensiveness of this study may be gained from the fact that the total number of accounts of sales covered at the five markets was over 300,000. The basic information obtained reveals the following facts:

(*a*) Total receipts of the markets studied, classified as to method of arrival, species, species combinations, and ownership.

(*b*) Detailed segregation of marketing expenses, classified according to arrival, species, species combinations, and ownership.

(*c*) Receipts in terms of actual number of cars, consignments, and owners and weights.

(*d*) Detailed information as to number of head, weight, dockage, price, marketing expenses (in detail), and net return to owner, ac-

cording to method of arrival, ownership, species, and species combinations.

(*e*) Detailed information as to classes of purchasers, sales, and disposition of receipts classified as to species.

The questions of general interest to the livestock producer, shipper, dealer, and the livestock public in general are marketing costs and returns. It was with these questions in mind that the livestock studies for the year 1921 were made, stressing at all times that, in order to get reliable information, actual facts and conditions should be ascertained, so far as they were disclosed by the written records. It was decided that as complete a study as possible should be made. Therefore the studies embody the consolidation of all accounts of sales rendered the shippers for the sale of livestock at the markets studied.

In addition to the foregoing, the division of audits and accounts undertook considerable statistical investigation and analytical work in order to aid the arbitrators in the disposition and settlement of the commission rate cases at the following markets:

| | |
|---|---|
| Chicago, Ill. | St. Paul, Minn. |
| Kansas City, Mo. | Fort Worth, Tex. |
| Omaha, Nebr. | Denver, Colo. |

The purposes of these studies were:

(1) To furnish information and data for the arbitrators in determining the reasonableness of the existing commission rate schedules.

(2) To discover and point out any outstanding inequities in the old schedules.

(3) To furnish data from which new and more equitable commission rate schedules could be developed.

With the above objects in view, the field work necessary to a study of this kind was started in 1922. The duplicate copies of original account sales on file in the offices of the livestock-commission concerns at the markets studied furnished the basis for the work. Data for each of the above markets were prepared for the years 1912, 1916, and 1922, using the months of January, April, June, and October of each year.

In order to determine the effect of any proposed increase or decrease in commission rates, it was deemed advisable to make an analysis of the actual operating results of several typical livestock-commission agencies with a view to determining the approximate profit or loss realized on each species of livestock. To obtain this result it was necessary to allocate the total commission collected according to species and prorate all commission-house expense which could not be charged directly to any one species of livestock. Arriving at the total profit or loss for species, the per car profit or loss for each class of livestock was then determined.

The material thus prepared has been particularly of value in connection with the commission-rate arbitration proceedings and has been made use of in various ways in addition to those already mentioned. It is felt that information of this nature is very helpful in the determination of the reasonableness of rates and charges at any given market.

In addition to the regular information procured through these audits and reports with reference to business transactions of the agencies involved, various irregularities were disclosed. Instances wherein this occurred have been given special attention in order that the information may be accurate and complete, and such information has been submitted to the division of the Packers and Stockyards Administration directly concerned for such formal or informal action as has been deemed essential in the carrying out of the purposes of the packers and stockyards act. In addition to this, the auditing division has cooperated with local organizations of market agencies as well as with stockyard companies by aiding them in dealing with irregularities which appeared to constitute violations of their rules and regulations. This was done when the consent referred to in Regulation No. 6 of the general rules and regulations had previously been given by the agencies concerned.

In every case such steps as were suitable to the nature of the case have been taken to secure the protection of shippers with whom dealings had been or were being conducted. These included not only payments of moneys due or other corrective action, but precaution for the future by way of separate banking accounts or otherwise improved banking methods, better accounting, surety bonds, and increased cash capitalization. One or two illustrations will serve to indicate the protection that is being afforded to shippers and the agencies on the public markets by the work of this division.

In the case of a commission agency which was solvent and in good standing, it was found by the auditors that there had been defalcations on the part of a bookkeeper amounting to over $5,000, approximately $1,000 of which was due the commission agency and approximately $4,000 was due shippers. As a result of this audit, the shippers were reimbursed for the entire amount due them.

In another case it was found that a commission agency was also engaged in buying livestock from other commission agencies and, with the assistance of a bank, at the time of the audit had been floating large amounts of drafts without livestock security, the amount outstanding at one time having been over $90,000. Through prompt action by the auditor and the supervisor, the amount of outstanding drafts was immediately made good by bank deposits. Subsequently, the concern involved discontinued business without loss to shippers or the other market agencies on the market.

Action which has grown out of these activities of the auditing division in the public livestock markets is covered in a general way in the appropriate places under the work of the other divisions involved.

The division of audits and accounts requested financial statements for the year 1922 from all concerns which, according to the best information available, are packers within the purview of Title II of the packers and stockyards act. Financial statements were received from 443 concerns, divided as follows:

Group 1. 386 concerns with net worth less than $1,000,000 each.
Group 2. 42 concerns whose net worth ran from $1,000,000 to $4,000,000 each.
Group 3. 10 concerns whose net worth ran from $4,000,000 to $16,000,000 each.
Group 4. 5 concerns whose net worth ran above $16,000,000 each.

There are a large number of small packers who question whether their business is of such a character as to render them subject to the

act, and a vast amount of correspondence has been and is being conducted in an effort to determine the proper status of these concerns.

The results of a similar survey of the financial affairs of the packing industry conducted in the previous year were used as the basis for figures furnished to the Senate and published in response to a Senate resolution in connection with the question arising out of the acquisition of Morris & Co.'s business by Armour & Co.

A thorough investigation of the financial and accounting affairs of Armour & Co. and Morris & Co. is in progress in order to aid in arriving at a proper understanding of the issues involved in the formal proceedings instituted by the Secretary of Agriculture.

## ECONOMICS.

### DOMESTIC ECONOMIC PROBLEMS.

Various economic problems in connection with the livestock and meat packing industry involving the Packers and Stockyards Administration both directly and indirectly have been given attention during the fiscal year, and as an indication of the nature of such problems brief reference is made here to some of the typical ones.

### THE EASTERN LAMB MARKET.

In cooperation with the Bureaus of Animal Industry and Agricultural Economics, the Packers and Stockyards Administration has given considerable attention during the year to efforts intended to stabilize conditions on the Jersey City lamb market. In this effort representatives of growers' organizations, State bureaus of markets, and the agencies of distribution at Jersey City and New York have assisted for the purpose of eliminating violent fluctuations in prices, as far as this could be accomplished by proper means.

New York City is the greatest outlet for mutton and lamb in America. The Jersey City market is its gateway. If prices drop to unduly low levels or fluctuate greatly there, the situation is reflected in lower or disturbed prices all over the country. The period of greatest disturbance occurs during June, July, and August, when the bulk of shipments comes from Ohio, Kentucky, Virginia, West Virginia, Tennessee, Pennsylvania, and New York. The situation is complicated by the fact that, in addition to eastern receipts, large and varying amounts of live and dressed lambs are received direct from western markets by eastern packers and packing connections.

Investigations soon disclosed that some of the causes of the trouble were remediable. Lambs and sheep that were properly docked and trimmed and well finished suffered relatively little from price discrimination. Inferior qualities brought from 50 cents to $1 per 100 pounds less than the desirable market grades.

This cooperative work is being continued during the new fiscal year. A number of demonstration shipments have been made and extension livestock agencies in the various States have taken energetic measures to improve the quality of shipments. The commission and other agencies in New York and Jersey City have helped distinctly by seeing to it that well-finished animals brought their true worth.

### RANGE-CATTLE MARKETING PROBLEMS.

The range-cattle industry has many problems peculiar to itself. Its marketing is a distinctly seasonal business. While shipments extend from July to December, over three-fifths of the total supply is usually marketed in September and October of each year, and over fifteen-sixteenths is marketed in the four months from August to October, inclusive. That the aggregate movement of westerners is a large one is evident from the fact that Chicago alone has received an average of 257,000 head a year of this class of cattle.

During September, 1922, complaints were received concerning prices paid to producers and other matters relating to range-fed cattle in the central markets. A careful investigation was undertaken to get the truth as nearly as possible for the benefit of all concerned. Typical lots of western rangers were traced through the stockyards, packing houses, and distributing branches of the packing companies, and, in addition, all other readily available sources of information were canvassed. It was found that while 1922 prices were below pre-war levels, they were higher than in 1921, indicating a trend in the right direction; that while packers do on occasion buy the whole of a large shipment, they do so unwillingly, stating that each can dispose advantageously of only a relatively small percentage of beef from grass-fed cattle; that the large packing companies are the principal outlet for westerners, the four largest companies taking 59 per cent in the typical period, leaving only 41 per cent for all other packers, yard traders, and feeder buyers; that wherever comparison was possible between prices paid by packers and feeder buyers taking parts of the same drive, the killer end brought better prices than the part destined for the feed lot; that both feeders and packers discriminate against horned rangers, because of difficulty of management, bruises, and retardation of gains if dehorned after purchase by the feeder; and that dressing percentages, shrinkage, and quality of product naturally favored corn-fed animals.

The information obtained was taken directly from the packer's records, taking into account the methods followed in making interdepartmental transfers, fixing market prices, etc.

Nine lots of range and two lots of corn-fed cattle were traced through. There were 3,228 head in all, but it was possible to follow only 778 all the way. Seven hundred and three of these were rangers. Seven lots of the latter showed losses and two gains. One lot of corn-fed steers showed a gain, the other a loss. The averages of both classes are indicated by the following summary:

| Average. | Range cattle. | Corn-fed cattle. |
|---|---|---|
| Dressing, per cent | 55.9 | 60.75 |
| Shrinkage, per cent | 2.7 | 1.9 |
| Dressed cost per 100 pounds | $11.17 | $14.70 |
| Selling price per 100 pounds | 11.40 | 17.97 |
| Loss per head | 3.47 | 1.05 |

A wide distribution was obtained for the meat from the range cattle. This assured average market conditions. In one case 97

head were divided between 23 markets. In another, 114 head reached 20 markets, while 121 head reached 15 markets and 15 head reached 4 markets.

Although every effort was made to select typical lots for tracing, and the tracing was done with the utmost care by an experienced investigator, and the figures as to yields, prices, and other facts were taken from the records of the packing companies, the number of lots was not great enough and the department's study of the packers' accounting and cost records has not gone far enough to warrant its unreserved sponsoring of the results. As conditions require and opportunity occurs, work of this character will be carried further.

### GENERAL ASSISTANCE TO THE LIVESTOCK INDUSTRY.

Cooperating with other branches of the department, particularly the Bureaus of Agricultural Economics and Animal Industry and the former Office of Home Economics of the States Relations Service, the Packers and Stockyards Administration has during the past year inaugurated certain activities to remove misapprehension on the part of producers, distributors, and consumers as to the department's attitude toward meat as a food.

The military and economic exigencies of the war period resulted in many highly intensive and successful efforts to conserve some products, both through restraining consumption and through substitution of others for them. In the case of meat, this was carried to the extent of questioning the wholesomeness and desirability of meat in the diet. One of the results was that it left in the public mind to some extent a scientifically inaccurate and economically unfair discrimination against meat as a food. The department, therefore, felt justified in undertaking some publicity to counteract the results of the previous campaigns with reference to meat consumption.

After due consideration it was decided that a poster in full colors would prove the most effective vehicle for conveying the department's position to the public. For pictorial attraction and appetite appeal the poster relies upon a well-cooked roast of beef in natural colors surrounded by browned potatoes and a green garnish. The printed matter is brief and to the point and attracts attention to the fact that meat is wholesome; that well-balanced meals promote health and vigor; and that in buying meats consumers should give attention to the full variety of kinds and cuts available, this chiefly with the underlying idea of economy.

The National Live Stock and Meat Board, made up of 11 producers, 2 packers, 2 retail representatives, and 2 livestock commission men, was invited to finance the lithographing and distribution of the posters, of which more than 100,000 have thus far been distributed in large size and over 3,000,000 in the form of a diminutive sticker. In this work not only the National Live Stock and Meat Board, but the Institute of American Meat Packers, American National Live Stock Association, National Wool Growers' Association, National Live Stock Exchange, National Association of Meat Councils, and the United Master Butchers' Association have cooperated.

### FOREIGN INVESTIGATIONS.

Studies in the foreign fields have related chiefly to concentration and integration of packing and other related enterprises with which American packers compete, both by reason of their manufacture of products and their exportation from the United States, and also through the operation of packing and distributing plants in South America, Europe, and other regions.

The principal points covered in the above-mentioned studies are summarized as follows:

(1) The meat requirements of Great Britain.

(2) Relation of British packing enterprises to the industry in America.

(3) Methods followed in Great Britain in the distribution of meats.

(4) The general economic situation.

In the intelligent administration of the packers and stockyards act the foreign as well as the domestic situation is being considered, with a view to giving every proper encouragement and help to the American livestock industry. It should be remembered that the United States may again be called upon to supply a large part of Europe's beef needs. While 1922 exports were almost negligible, in 1917 and 1918 combined we exported nearly 1,200,000,000 pounds of beef and its products.

### BACON TRADE PROMOTION.

During and immediately after the war, American bacon acquired an unwarranted reputation in Europe. This was due to the fact that the foreign contract specifications called for exclusively heavy cures to insure preservation, and was also due to the fact that cargoes, after arrival in Europe, were held for long periods pending disposal. Consumers naturally objected to this situation and bought other types of bacon when they could be secured. To help remove any remaining prejudice against American bacon, a film entitled "Behind the Breakfast Plate" has been prepared for distribution in Great Britain and elsewhere in Europe. It is available in French, German, Italian, Dutch, and Norwegian forms. Distribution is getting under way in England and Germany and to a less extent in France and Austria. In Germany an agreement has been made with one of the largest moving-picture distributing organizations, as a result of which showings are promised to 3,500 cinemas.

## LAW.

The work of this division is tied up and integrated with that of all the other divisions of the administration. Therefore, it is embraced to a considerable degree in all the activities of the organization. In this connection special attention is directed to the "docket report," in which the work of this division is reflected in a very large measure. This consists in the preparation or review of complaints, the testimony and findings of facts in formal hearings, orders, and other documents of a formal character.

This division participates in informal discussion and conferences wherein legal questions are involved, and it gives opinions in connec-

tion with current correspondence and problems. It forms the point of contact between the Packers and Stockyards Administration and the Solicitor of the Department in all matters requiring supervision by that officer.

Heavy demands have been made upon this division for work in connection with the organization and patronage dividend methods of cooperative selling agencies, the banking and bonding problem of the commission business, the valuation of stockyard properties, and the handling and disposition of formal proceedings, including particularly the Armour-Morris matter.

### AMENDMENT NO. 1 TO REGULATIONS.

On June 14, 1923, an amendment to Circular No. 156, which becomes effective September 1, 1923, was approved, requiring market agencies engaged in selling livestock on a commission to provide adequate bonds to protect shippers and also to handle all shippers' proceeds in such a way as to prevent their being intermingled or confused with other funds of the market agency kept or used for other purposes. The need for such a regulation in the interest both of the commission agencies themselves and the shippers was demonstrated by the number of cases, which threatened to be serious, although fortunately handled without ultimate loss to shippers, that were found of insolvency or faulty financial practices. Had it not been for financial aid by other members of the trade and by bank loans, together with indulgences by shippers, losses would have occurred. The dangers of such cases was so great that after full consideration by the leading interests in the industry the regulation was decided upon as an urgent precautionary measure. In fact, the justification for such a regulation has been recognized through voluntary action in a number of markets.

### FORMAL DOCKETS.

In addition to cases originating during this fiscal year, this report includes also all cases that were pending at the close of the fiscal year ending June 30, 1922.

*Docket No. 1.* Kansas City Live Stock Exchange, complainant, *v.* Armour & Company and Fowler Packing Company, respondents. The Kansas Live Stock Association, The Missouri Live Stock Producers' Association, The National Live Stock Producers' Association, Missouri Farmers' Association, and Farmers Union of Kansas, interveners.

This was a complaint filed by the Kansas City Live Stock Exchange, which is composed of commission men in the Kansas City market, against Armour & Co. and the Fowler Packing Co., with respect to the operation by the Fowler Packing Co. of its yards, known as the Mistletoe Stock Yards, at Kansas City, Kans., a short distance from the Kansas City public stockyards. The Fowler Packing Co. is owned by Armour & Co. It was complained that the Mistletoe Stock Yards was really a public stockyard market within the meaning of Title III of the packers and stockyards act and should be so determined by the Secretary of Agriculture. It was also complained that the methods of doing business in these yards were contrary to Title III relating to stockyards and to Title II relating to packers under the packers and stockyards act because of alleged

unfair, unjustly discriminatory, and deceptive practices, and, further, because the buying operations of the two respondent concerns were alleged to affect adversely the interests of producers and shippers who patronize the Kansas City public stockyards by depressing the prices in that market. A formal hearing was held at Kansas City, Mo., before an examiner of the Packers and Stockyards Administration, beginning March 27, 1922, and lasting 12 days. The various associations named as interveners participated in the hearing for the purpose of assisting in having the facts developed completely.

Following the hearing, proposed findings of fact and briefs were submitted by the parties, and tentative findings of fact were prepared and submitted to the parties by the examiner. The proceeding was pending consideration of these findings of fact on June 30, 1922. Early in the current fiscal year conclusions were issued by the Secretary that the respondents had violated Title II, section 202, of the act, but that the yards in question were not a public stockyard market under Title III, and the following order, effective August 30, 1922, was made:

1. *It is ordered* that the motion of the respondents to dismiss the complaint as amended be sustained as to the charges of the complaint as amended under Title III of the Packers and Stockyards Act, 1921, and that said motion be overruled as to the charges of the complaint under Title II of said Act.

2. *It is ordered* that the respondents, and either of them, their officers, directors, agents, employees, and servants, in their business in commerce as defined in the Packers and Stockyards Act, 1921, cease and desist from continuing the violation of Title II, section 202 of said Act, by protecting or causing to be protected the shippers of the Fowler Packing Company at their respective shipping points, that is to say, by preventing or forbidding, by agreement, arrangement or otherwise, any shipper from engaging in competition with any other shipper in buying hogs in their respective territories or localities.

3. *It is ordered* that the respondents, and either of them, their officers, directors, agents, employees, and servants, in their business of buying hogs in commerce as defined in the Packers and Stockyards Act, 1921, at the Mistletoe Stock Yards, cease and desist from continuing the violation of Title II, section 202 of said Act by representing or announcing to the shippers of the Fowler Packing Company that it will not feed corn in the Mistletoe Stock Yards while furnishing a corn fill to its shipper Jesse G. Hawkins of Franklin, Nebraska, or any other shipper, or by withholding or agreeing to withhold from, or denying a corn fill in said yards to the hogs of any of its shippers while furnishing such fill in said yards to the hogs of other shippers, under like conditions and circumstances.

4. *It is ordered* that the respondents shall within thirty days after the day of service upon them of this order file with the Secretary of Agriculture a report in writing, setting forth in detail the manner and form in which this order has been complied with.

The respondents filed an acceptable plan.

*Docket No. 5.* The Secretary of Agriculture *v.* The Peoria Union Stock Yards Company, Peoria, Ill.

*Docket No. 6.* The Secretary of Agriculture *v.* Union Stock Yards Co. of Omaha (Ltd.), South Omaha, Nebr.

*Docket No. 7.* The Secretary of Agriculture *v.* Union Stock Yard & Transit Co., Chicago, Ill.

Following the assumption of jurisdiction by the Secretary of Agriculture at the stockyards at Peoria, Ill., South Omaha, Nebr., and Chicago, Ill., it appeared that a new charge not previously imposed was being exacted by the stockyard companies from traders on account of the reweighing of livestock necessitated by their transactions. The major portion of the revenues of the stockyard companies is derived from the yardage charges assessed against live-

stock in the hands of commission men and from the feeding of livestock in the yards. The traders complained that the new charge was unfairly discriminatory and excessive. Its consideration involved the consideration of other charges of the stockyard companies in case it was found that any readjustment of charges should be made in order to satisfy the complaints. The stockyard companies insisted upon the propriety of the new charges and the justice of their contentions, and accordingly it was necessary to issue formal complaints.

The hearing upon the complaint in Docket No. 5 was begun in Peoria on July 6, 1922, and was continued on September 25, 1922, at which time the stockyard company presented an appraisal of its property. A special hearing was held in Chicago on October 9 for the purpose of cross-examining the engineers who had prepared this inventory and appraisal. Owing to the illness of the president of the stockyard company it was impossible to complete the hearing. The hearing was again resumed on February 6, 1923, at which time it developed that the stockyard company had purchased the land which it had formerly held under a lease. In order to develop further evidence regarding the value of this land the hearing will be resumed on July 13, 1923.

The hearing in Docket No. 6 was held at Omaha on September 18, 1922. On June 22, 1923, the Secretary of Agriculture made his findings and conclusions, in which he states that the rate or charge complained of is discriminatory and, therefore, contrary to and in violation of Title III of the packers and stockyards act, 1921. An order was issued on that date commanding that the respondent and its officers, directors, agents, and employees cease and desist from continuing the violation of said Title III. This order was made effective July 10, but the time was later extended to August 1, 1923.

Similar findings and order were issued in Docket No. 7.

*Docket No. 8.* The Secretary of Agriculture *v.* Eidson-Hopkins Co. and others, Baltimore, Md.

The complaint in this proceeding was issued as a result of the receipt of complaints from shippers who protested against a proposed schedule of charges of the Baltimore Live Stock Exchange, whereby there would be exacted, in addition to the regular commission charge, 50 cents for each additional account sales after the first two on cooperative shipments handled by exchange members. This charge on its face appeared to be excessive compared with the value of the service rendered, and the tariff was suspended.

A hearing was held on August 17, 1922, and during the hearing the representatives for the shippers proposed a charge which they considered reasonable for prorating plural ownership shipments of livestock. They proposed the following charge:

> On carlots of stock belonging to more than one owner, which, by reason of such plural ownership, require additional services, such as sorting, selling, weighing, or accounting on account of brands, marks, or other identification, or at the request of the shipper, there shall be charged, in addition to the regular rate of commission, the following:
>
> | | |
> |---|---|
> | For more than 1 and not more than 5 owners | $1.00 |
> | For more than 5 and not more than 10 owners | 1.50 |
> | For more than 10 and not more than 20 owners | 2.00 |
> | For more than 20 owners | 3.00 |

The respondents agreed to this proposal, and order was issued by the Secretary on the 25th day of August, 1922, requiring that the charge agreed upon be made a part of the published tariff of the respondent market agencies.

The original notice of hearing also provided for a general inquiry into the basic commission charges made by the members of the Baltimore Live Stock Exchange. A hearing was held on this general inquiry on June 22 and 23, 1922.

*Dockets Nos. 9 to 14, inclusive.*

American National Live Stock Association, National Wool Growers' Association, Arizona Cattle Growers' Association, Arizona Wool Growers' Association, California Cattlemen's Association, Corn Belt Meat Producers' Association, Idaho Cattle and Horse Growers' Association, Montana Stock Growers' Association, Nebraska Stock Growers' Association, Nevada Land and Live Stock Association, New Mexico Cattle and Horse Growers' Association, Oregon Cattle and Horse Raisers' Association, Texas and Southwestern Cattle Raisers' Association, Utah Cattle and Horse Growers' Association, Wyoming Stock Growers' Association, *Complainants,*

*v.*

The Chicago Live Stock Exchange, The Kansas City Live Stock Exchange, The Omaha Live Stock Exchange, The St. Paul Live Stock Exchange, The Portland Live Stock Exchange; and those market agencies operating at the stockyards at Chicago, Ill.; Kansas City, Mo.; Omaha, Nebr.; St. Paul, Minn.; Portland, Oreg.; and Fort Worth, Tex., that have registered with the Secretary of Agriculture under section 303 of the Packers and Stockyards Act, 1921, *Defendants.*

These are complaints against the commission charges at Portland, Fort Worth, Kansas City, Omaha, St. Paul, and Chicago. Before the date of hearing was ordered on this complaint a conference was held by the representatives of the market agencies at the Kansas City market and representatives of the American National Live Stock Association, Kansas Live Stock Association, Missouri Live Stock Association, Texas and Southwestern Cattle Raisers' Association, and other livestock organizations tributary to the Kansas City market. This conference resulted in the proposal to the Secretary that the issues in dispute be settled by arbitration. G. N. Dagger, in charge of the division of rates, charges, and registration, and Howard M. Gore, in charge of the division of trade practices, of the Packers and Stockyards Administration, were selected as arbitrators. This form of procedure was approved by the Secretary. The same form of procedure was agreed upon at Omaha, St. Paul, and Chicago. A hearing was held at Kansas City, beginning October 30, 1922. A hearing was held at Omaha on March 26, 1923, at St. Paul on February 19, 1923, and at Chicago, March 5, 1923. These hearings were widely announced, and all parties were present and presented their facts and suggestions with reference to the commission rates. In addition, the division of audits and accounts of the Packers and Stockyards Administration made an audit of the books of the commission firms. The arbitrators made considerable investigation on their own account and required numerous reports from commission firms regarding their business, organization, and operations. A preliminary informal report was made to the Secretary on the rates at Kansas City, Omaha, St. Paul, and Chicago before the close of the fiscal year, and the final report of the arbitrators has since

been submitted and approved. This form of procedure has been characterized by interested parties as one of the greatest steps forward in the industry in many years, and is an evidence of high confidence in the officers of the Packers and Stockyards Administration who were selected by the parties as arbitrators. On the basis of information in the possession of the arbitrators, it is estimated that the new rates would reduce the total revenues of the commission agencies in the four markets on the same volume of business by about $750,000 per annum. The arbitrators' decision is resulting in voluntary corresponding reductions in a number of other markets not covered by the arbitrators.

A formal hearing was begun at Fort Worth on March 19, 1923. After continuing several days it was proposed by the complainants that the issues in dispute be submitted to arbitration in accordance with the plan at the other markets. This was agreed between the parties and the procedure was approved by the Secretary. The case is now pending.

The complaint against the commission firms at the Portland market has not been set for a hearing.

*Docket No. 15.* The Secretary of Agriculture *v.* American Commission Co. and others.

The hearing with reference to the proposed increase in commission charges of the Denver Live Stock Exchange was opened December 19, 1922, in the Exchange Building, Denver Union Stock Yards. The representatives of the various producers' organizations appeared for the purpose of presenting their testimony regarding the advisability of a new charge. The new tariff, which had been suspended for two 30-day periods, would have become effective on January 1, 1923, as the period of the extension expired December 31, 1922. However, the Denver Live Stock Exchange withheld the operation of the new tariff and did not make it effective until March 19, 1923. The hearing was continued on March 12, 1923, and the report of the results of the investigation of the division of audits and accounts was made a part of the record. The case is still pending.

*Docket No. 16.* The Secretary of Agriculture *v.* Union Stock Yard & Transit Co., Chicago, Ill.

On December 14, 1922, a hearing was conducted at Chicago for the purpose of investigating the reasonableness of an advance of 15 cents per bushel in the price of corn, as proposed by the stockyard company. The new tariff, which had previously been suspended, became effective December 21, 1922. As there was considerable information which had not been checked over by the auditing division, the record in the case was made a part of the general inquiry in Docket No. 7. A basis for the determination of reasonable stockyard charges is now under consideration in these dockets.

*Docket No. 17.* The Secretary of Agriculture *v.* Milwaukee Stock Yards Co., Milwaukee, Wis.

The Milwaukee Stock Yards Co. filed a supplement to its tariff increasing the price of corn 15 cents a bushel. This tariff was suspended for a 30-day period and a hearing was ordered to be held December 28, 1922. Before the time of hearing the respondent com-

pany asked permission to withdraw the supplement and restore its previous charge of $1.10 per bushel. Based on information in possession of the administration, the request was granted and the case was dismissed.

*Docket No. 18.* The Secretary of Agriculture *v.* Nashville Union Stock Yards (Inc.), Nashville, Tenn.

On January 23, 1923, the Secretary of Agriculture suspended tariff No. 5 filed by the Nashville Union Stock Yards Co. This new tariff provided for an increase of yardage on all livestock, the increase on stock arriving by truck being more than that on stock arriving by rail. In view of the information in possession of the Packers and Stockyards Administration, it did not appear that the increase was justified. The stockyard company refused to accept certain suggested modifications of the tariff and requested a formal hearing. The schedule was suspended for 30 days from January 26, the date on which the schedule would otherwise have become effective. The hearing was ordered to be held on February 14, but was postponed by request of the stockyard company until April 17. On February 16 the Nashville Union Stock Yard Co. made a request to withdraw tariff No. 5, which had been suspended pending proceedings, and asked permission to file a new tariff containing the same rates as provided in tariff No. 4, which was in effect at the time the proceeding was begun, except as to stock received other than by rail, with respect to which the new tariff would provide yardage charges at the following rates: Cattle, 35 cents per head; calves, 20 cents per head; hogs, 14 cents per head; sheep, lambs, goats, and kids, 12 cents per head. This request was granted, and the proceeding was terminated by order of the Secretary on February 21, 1923.

*Docket No. 19.* The Secretary of Agriculture *v.* Armour & Co. of Illinois, Armour & Co. of Delaware, J. Ogden Armour, Morris & Co., and the North American Provision Co., *Respondents.*

This is a proceeding instituted under the packers and stockyards act by the Secretary of Agriculture against Armour & Co. of Illinois, Armour & Co. of Delaware, J. Ogden Armour, and Morris & Co., as respondents, by notice and complaint issued February 17, 1923, and served on respondents February 26, 1923. The object of the complaint is to determine the validity of the acquisition of the assets, business, and good will of Morris & Co., the third largest packer in the United States, by Armour & Co., the second largest packer. After filing the complaint, it was amended by adding the North American Provision Co. as respondent.

The answers of the respondents denied that the acquisition of the assets, business, and good will of Morris & Co. by the Armour respondents would lessen competition in the purchase of livestock or the sale of the products thereof, and asserted that such acquisition was an industrial and economic necessity.

Hearings have been held at Kansas City, East St. Louis, Omaha, and Chicago. At the close of the fiscal year the case was pending, the hearing to be resumed September 18, the place to be announced later, at which hearing the Government will proceed with the introduction of further testimony.

*Docket No. 20.* Secretary of Agriculture *v.* East Tennessee Stock Yards, Knoxville, Tenn.

A hearing was ordered by the Secretary of Agriculture on the reasonableness of the increase in charges for corn, oats, bran, and cottonseed meal, proposed by the East Tennessee Stock Yards, of Knoxville, Tenn., in its tariff No. 3, filed with the Packers and Stockyards Administration on March 9, 1923. This hearing was to have been held on April 11, 1923. Upon request, information pertaining to the matters involved in this proceeding was furnished by the stockyard company to the Packers and Stockyards Administration, and the proceeding was ordered dismissed, and the respondent's tariff No. 3 was filed, effective April 6, 1923.

*Docket No. 21.* The Secretary of Agriculture *v.* Newark Stock Yards, Newark, N. J.

An increase in the price of corn and hay was provided for in supplement No. 3, tariff No. 1, of the Newark Stock Yards, Newark, N. J., filed with the Packers and Stockyards Administration on March 10, 1923. This supplement was suspended for a 30-day period, and a hearing was ordered to be held on April 17, 1923. Before the date of hearing the stockyard company asked permission to withdraw supplement No. 3 and continued the charges provided in tariff No. 1. This request was granted and the case was dismissed by order of the Secretary, issued April 11, 1923.

*Docket No. 22.* (Number not used.)

*Docket No. 23.* The Secretary of Agriculture *v.* Seattle Union Stock Yards Co., Seattle, Wash.

By order of March 30, 1923, the Secretary of Agriculture suspended tariff No. 2 filed by the Seattle Union Stock Yards Co. increasing yardage charges and charges for alfalfa hay. The new tariff was suspended for a 30-day period from April 1, and a hearing was ordered to be held beginning April 30, 1923. The tariff was suspended for a second 30-day period and hearing continued to May 14, 1923. The respondent company requested permission to withdraw its suspended schedule and substitute a new schedule in lieu thereof. The new schedule as proposed eliminated the discriminatory features of the previous schedule and made other satisfactory modifications. The proceeding was dismissed and terminated without prejudice by order of the Secretary of Agriculture, dated May 11, 1923.

*Docket No. 24.* The Secretary of Agriculture *v.* The Pittsburgh Union Stock Yards Co., Pittsburgh, Pa.

On May 29, 1923, a hearing was ordered on the reasonableness and lawfulness of the Pittsburgh Union Stock Yards tariff No. 5, which provided for an increase of 15 cents per bushel in the price of corn. A general inquiry was ordered made into all stockyard charges provided for in tariff No. 5. A hearing was held on June 18 and adjourned without date, pending the collection of information regarding the value of certain property used in rendering stockyard services.

*Docket No. 25.* The Secretary of Agriculture *v.* Michigan Central Railroad Co.

On June 26, 1923, a hearing was ordered on the reasonableness and lawfulness of the increased yardage charges at the Detroit stock-

yards, as provided for in its tariff No. 3 filed on May 16, 1923. The order also directs a hearing into all rates and charges made by the respondent company for stockyard services at the Detroit Stock Yards, Detroit, Mich. This hearing was held on September 10, 1923.

*Docket No. 26.* The Secretary of Agriculture *v.* New York Central Railroad Co.

On June 26, 1923, a hearing was ordered by the Secretary of Agriculture on the reasonableness and lawfulness of the increased yardage charges provided for in the Buffalo Stock Yards tariff No. 4 filed by the New York Central Railroad Co. on June 4, 1923. The order also directs a general inquiry into the reasonableness and lawfulness of all rates and charges for services rendered by the respondent company at its stockyards at Buffalo, N. Y. The hearing was held on September 13, 1923.

*Docket No. 27.* In re Charles H. Shurte.

On June 27 the Secretary of Agriculture, having reason to believe from information at hand that Charles H. Shurte, while engaged in the commission business, had violated Title III of the packers and stockyards act, 1921, and it appearing that an investigation and proceeding under Title III would be in the interest of the public, instituted an inquiry and issued complaint and notice of hearing to be held in Chicago on July 9.

# REPORT OF ADMINISTRATION OF GRAIN FUTURES ACT.

UNITED STATES DEPARTMENT OF AGRICULTURE,
GRAIN FUTURES ADMINISTRATION,
*Washington, D. C., September 20, 1923.*

SIR: I respectfully transmit herewith my annual report for the Grain Futures Administration for the fiscal year ending June 30, 1923.

Respectfully yours,

CHESTER MORRILL,
*Assistant to the Secretary.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

As stated in the annual report for the fiscal year ending June 30, 1922, for the Administration of the Grain Future Trading Act of August 24, 1921, that act was found unconstitutional in certain respects by the Supreme Court of the United States on May 15, 1922, and there was pending in Congress at the close of the fiscal year a bill framed under the interstate-commerce power of Congress to take the place of the previous statute. This new bill was approved by the President on September 21, 1922, with a provision making it operative on November 1, 1922. The present law is designated as the "grain futures act," instead of the "future trading act," the name by which the former statute was known.

The Chicago Board of Trade and the future exchanges at Minneapolis, Kansas City, St. Louis, and Duluth instituted suits in the Federal courts in their respective districts to test the constitutionality of the new statute. Temporary stays of the enforcement of the law as to these exchanges were granted pending hearings, and the suits of all of these exchanges except the Chicago Board of Trade were held in abeyance awaiting the outcome of its case. The other exchanges did not contest, but the Toledo Produce Exchange announced its discontinuance of trading in grain futures as a protest against the new law. An answer was filed to the bill of complaint of the Chicago Board of Trade, and when the case came to be heard the lower Federal court dismissed the bill of complaint and denied the application for a restraining order. An appeal was taken by the Chicago Board of Trade to the Supreme Court of the United States, and a stay of enforcement of the law was granted pending the decision by that court. In an opinion handed down by Chief Justice Taft on April 16, 1923, the Supreme Court upheld the constitutionality of the statute, and referred to its former deci-

sion as being in effect an authority for and not against the enactment of the present law.

Ten exchanges in all have been designated as "contract markets" under the present act. These are the Board of Trade of the City of Chicago and the Open Board of that city, Milwaukee Chamber of Commerce, Minneapolis Chamber of Commerce, Duluth Board of Trade, Kansas City Board of Trade, St. Louis Merchants' Exchange, Baltimore Chamber of Commerce, Grain Trade Association of the San Francisco Chamber of Commerce, and Los Angeles Chamber of Commerce. The designation for San Francisco is limited to barley and that for Los Angeles is limited to barley, corn, and sorghums. The action upon these applications by the department was facilitated by its experience and knowledge gained under the future trading act.

In substance, the provisions of the grain futures act correspond with the provisions of the future trading act, with the exception that section 3 of the former statute, which contains the tax on "puts and calls" and like transactions, and which was not held invalid by the Supreme Court and therefore remains in effect, was not reenacted. The place of this section was taken by a new section 3, which constitutes a finding by Congress of the relation of grain future trading to the cash grain business and the necessity for national regulation. This section was vigorously attacked in the suit to test the constitutionality of the statute, but the Supreme Court held that Congress was justified in making such a finding and enacting the statute.

Section 4 of the grain futures act prohibits the use of interstate instrumentalities in connection with the execution of contracts for future delivery of grain with certain specified exceptions. In this connection, the act expressly provides that contracts of sale of cash grain for deferred shipment or delivery are not to be regarded as futures. The most important of the exceptions made by the statute is that which permits transactions made by or through members of boards of trade which hold designations by the Secretary of Agriculture as "contract markets" through compliance with conditions set out in section 5. In substance, these conditions are (*a*) that each such "contract market" must be located at a terminal market where cash grain of the kind specified in the contracts of sale of grain for future delivery to be executed on such board is sold in sufficient volumes and under such conditions as fairly to reflect the general value of the grain and the differences in value between the various grades of such grain, and where there is available to such board of trade official inspection service approved by the Secretary of Agriculture for the purpose; (*b*) that the governing board of the "contract market" must provide for the making and filing of reports showing certain information as to cash and future transactions by the board members and for the keeping of certain records; (*c*) that the governing board must provide for preventing the dissemination by the board or its members of false or misleading or knowingly inaccurate reports concerning crop or market information or conditions that affect or tend to affect the price of grain in interstate commerce; (*d*) that the governing board must provide for the prevention of manipulation of prices or the cornering of any grain on such board; and (*e*) that membership in such boards must not be

denied to lawfully formed and conducted cooperative associations of producers, having adequate financial responsibility, engaged in the cash grain business, which comply and agree to comply with the rules of such boards applicable to other members, with a special proviso to the effect that rules against rebating commissions shall not prevent the distribution of net receipts of such associations to the bona fide members thereof on a patronage basis.

Section 9 authorizes the Secretary of Agriculture to make investigations regarding the operations of the boards of trade and the marketing conditions of grain and grain products and by-products and to publish the results thereof.

There are other provisions of the statute which, however, are incidental to its main provisions.

The statute does not prohibit or prevent the use of futures for hedging or ordinary speculation, but is designed to prevent the dissemination of false or misleading information about crop or market conditions, to stop manipulations and controls or attempted corners of the market, and to enable the Secretary of Agriculture to procure and publish authentic information regarding the business conducted on grain-future exchanges and its effect upon the cash grain trade, including the producers and consumers of grain and grain products.

The funds for carrying out the provisions of the future trading act of August 24, 1921, were made available by Congress for carrying out the provisions of the grain futures act.

During the period of litigation involving the constitutionality of this legislation a skeleton organization has been maintained with offices at Chicago and Minneapolis in charge of grain-exchange supervisors (Dr. J. W. T. Duvel at Chicago and J. R. Mathewson at Minneapolis) devoted to the purpose of becoming familiar as far as possible without mandatory authority with the trading organizations and the methods of doing business in the various future markets. An analysis was made of records in the possession of the Government showing purchases and sales of each kind of grain for each delivery month on each of the boards of trade, and this information has been tabulated and to a considerable extent placed in chart form for reference purposes and as a basis for comparison with additional information gained in the active administration of the law.

Tentative regulations under the grain futures act, which had been held in abeyance pending the decision of the Supreme Court, were given out promptly to all interested persons for criticism and, after suggestions and expressions of views had been obtained both in writing and orally, the final regulations were promulgated by the Secretary of Agriculture on June 22, 1923. These regulations contain, among other things, provision for the making of daily reports by clearing members of the exchanges to the Grain Futures Administration, showing their total purchases and sales of each kind of grain for each delivery month, their net positions, the aggregate of their "long" and the aggregate of their "short" open accounts making up such net positions, their receipts and deliveries of grain on future contracts, and the net positions of open accounts on their books for customers, amounting, in practice, in the case of wheat at Chicago, to 500,000 bushels or more, and varying amounts for other kinds of grain and the different markets. These figures are subject

to change when conditions justify. They are not, however, limits upon the amount of trading that any person may do.

Strenuous objection was made to such requirements by representatives of the leading grain exchanges on the ground that it would impose an unnecessary burden and hardship on members of the future exchanges to make such reports daily; that the Government should not be in possession of such information currently because of the possibility of leaks as to the business of individual concerns; and that speculation would be discouraged thereby. It was felt that these objections could not be sustained, because to do so would impair the accomplishment of the purposes of the law, which necessitates accurate current knowledge of the actual operations on the exchanges.

As soon as possible after the regulations were promulgated the necessary forms for use in making the reports were prepared and put into service. It has already been found in the short period that has elapsed that substantially all reports are received within the time required, and it is expected that soon there will be no failures in this regard.

However, in the meantime, there was a substantial decline in the price of wheat in both the future and the cash grain markets, and for a time there was in progress what amounted to a propaganda to the effect that the Government's requirements of daily reports and access to information as to customer's accounts had frightened speculative buyers away from the markets and lessened the volume of trading so that the support for the market was impaired. It was pointed out in published statements by the Secretary of Agriculture and the Grain Futures Administration that such allegations were not based upon fact, but that conditions in the wheat market were due to causes other than the administration of the grain futures act. It was further pointed out that during the period when the price of wheat had gone down the price of corn had risen very substantially, although traded in on the same markets under precisely the same regulations as wheat. Since the close of the fiscal year there was an upward tendency in the wheat market, notwithstanding the fact that there has been no alteration in the Government's requirements.

As an aid to the administration of the law, the Grain Futures Administration has secured the creation for the Chicago Board of Trade of a grain futures committee composed of representatives of the various groups interested in future trading, who meet with the Government supervisor, so that local questions arising in connection with the enforcement of the law may be considered promptly in a practical way by well-informed men on the ground.

At the close of the fiscal year the Grain Futures Administration was strengthening its organization for carrying out the provisions of the new law and was making plans for the work required in order that it might obtain definite knowledge upon various phases of grain-future trading which would be of value in a dispassionate consideration of the functions performed by those organizations. Plans were also being made for a coordination of governmental agencies for gathering information so as to effectuate the provisions of the grain futures act against the dissemination of false or misleading information regarding crop or market conditions.

# REPORT OF THE SOLICITOR.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SOLICITOR,
*Washington, D. C., September 15, 1923.*

SIR: I submit herewith report of the work of the office of the solicitor for the fiscal year ended June 30, 1923.

Respectfully,

R. W. WILLIAMS, *Solicitor.*

Hon. HENRY C. WALLACE,
*Secretary of Agriculture.*

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The outstanding feature of the year was the greatly increased reliance of the United States attorneys upon this office for relief and aid in the preparation and trial of the department's litigated cases. As a consequence, there was a marked increase in the number of complaints, indictments, informations, petitions, motions, briefs, and other pleadings prepared for filing and in the attendance of members of the office at the trial tables in the courts. This was distinctly advantageous to the department, for it enabled its lawyers, who are specially trained in its work, to present the cases to the courts, and thus insured a more thorough presentation than could be expected of United States attorneys, who are usually overburdened with the vast and varied litigation of the Government in their districts, and who, therefore, very naturally can not devote to the department's litigation that attention which can be given by our own lawyers. It is a gratification to report that our relations both with the Department of Justice in Washington and with the United States attorneys in their respective districts are most cordially and mutually helpful.

From time to time, in the reports of this office, lists have been given of the principal regulatory statutes administered by this department. This list is augmented from year to year by additional regulatory statutes enacted by Congress. During the year just closed there were added to the list the grain futures act, the naval stores act, the act regulating the importation of adult honeybees, and the United States cotton standards act. There was also enacted the general statute applicable to all the departments, authorizing the heads thereof to adjust and report to Congress claims not in excess of $1,000 growing out of damage resulting from negligence of department employees. Inevitably these statutes increase the legal as well as the administrative work of the department.

The constitutionality of the grain futures act was sustained by the Supreme Court in the Board of Trade of the City of Chicago et al. *v.* Olsen et al. (262 U. S., 1). The ruling of the department on the labeling under the food and drugs act of vinegar made from evaporated apples was sustained by the District Court for the

Northern District of Ohio, but was reversed by two of the three judges of the Circuit Court of Appeals for that circuit. The Government's petition for a rehearing was denied and steps were taken to remove the case to the Supreme Court of the United States for review. Conspicuous success attended the department's efforts through the courts to enforce payment to the Government of excess profits made on the wool clip of 1918 by licensed wool dealers operating under the regulations of the War Industries Board, the duty of collecting and distributing these excess profits having been transferred to the Department of Agriculture after the War Industries Board ceased to operate. This work is more particularly referred to elsewhere in this report.

The long-mooted question of the right of an employee of the department to bear arms in the discharge of his duties under penal statutes committed to the department for enforcement, notwithstanding State laws restricting the privilege of bearing arms to a limited class of officers of the State, was presented during the year to the United States District Court for the Northern District of West Virginia in the case of the arrest, trial, conviction, and sentence under State law of one of the department's forest rangers. That court held that the forest ranger had the right to bear arms in the discharge of his duties, notwithstanding the State law, and the ranger was released from the custody of the State authorities.

I am pleased to report that there was no addition to the working force of this office during the year.

Much of the work of the office can not be presented statistically; neither is it practicable to preserve a record of all of its work. Administrative officials of the department were in daily consultation with the lawyers in the office on legal questions arising in the administration of their several bureaus. Frequent conferences were had with persons whose business is affected by the laws administered by the department, and many letters were written in response to letters of inquiry from correspondents who wished information on a very wide range of legal subjects. The volume of the letters prepared in the various bureaus for the Secretary's signature and referred to the Solicitor for examination before presentation to the Secretary was quite large. Drafting of new and revision of existing regulations under the various regulatory laws administered by the department assumed substantial proportions during the year.

The following is a summary of the work of the office during the year, so far as it is possible to present it statistically:

Four hundred and fifty-nine formal written opinions were rendered the administrative officials of the department. No record was preserved of the advice given these officials in daily informal consultations, nor of opinions expressed by brief pencil notations on papers sent to the office for consideration.

Pursuant to authority of section 4 of the food and drugs act and section 4 of the insecticide act, 1,150 notices of judgments were prepared for publication. In addition to the criminal prosecutions below tabulated, 737 decrees of condemnation and forfeiture were entered under the food and drugs act and 8 under the insecticide act.

There were reported to the Department of Justice 2,478 violations of statutes intrusted to the department for enforcement.

The following table shows the several statutes under which these violations were reported and the amounts of fines and recoveries in cases settled with and without contests:

*Cases reported, fines imposed, and judgments recovered.*

| Law involved. | Number of cases. | Fines and recoveries. |
|---|---|---|
| National forest laws | 161 | $30,232.66 |
| Food and drugs act | 919 | 18,237.00 |
| 28-hour law | 595 | 171,300.00 |
| Animal quarantine acts | 80 | 13,396.00 |
| Meat inspection act | 36 | 1,289.50 |
| Lacey Act | 5 | 225.00 |
| Migratory bird treaty act | 492 | 7,084.01 |
| Game law violations in national forests | 61 | 1,823.40 |
| Pisgah game preserve | 5 | 100.00 |
| Insecticide act | 51 | 2,322.00 |
| Plant quarantine act | 63 | 1,361.00 |
| United States grain standards act | 5 | 400.00 |
| Miscellaneous | 5 | 125.00 |
| Total | 2,478 | 247,895.57 |

Many cases involving alleged violations of the regulatory laws were given consideration that were not reported to the Department of Justice, owing to the absence of sufficient evidence on which to base prosecution.

Contracts and leases were prepared or examined as follows:

*Contracts and leases prepared or examined.*

| Bureau, division, or office. | Contracts. | Leases. | Total. |
|---|---|---|---|
| Forest Service | 1,278 | 11 | 1,289 |
| Bureau of Animal Industry | 4 | 21 | 25 |
| Biological Survey | | 2 | 2 |
| Bureau of Chemistry | | 1 | 1 |
| Chief Clerk | 6 | 18 | 24 |
| Bureau of Entomology | 1 | 39 | 40 |
| Bureau of Agricultural Economics | 7 | 46 | 53 |
| Federal Horticultural Board | 1 | 2 | 3 |
| Insecticide and Fungicide Board | 3 | 2 | 5 |
| Mechanical shops | 2 | | 2 |
| Packers and Stockyards Administration | | 8 | 8 |
| Bureau of Plant Industry | 12 | 27 | 39 |
| Bureau of Public Roads | 7 | 16 | 23 |
| Division of Publications | 1 | | 1 |
| Weather Bureau | 8 | 30 | 38 |
| Grain Futures Trading Administration | | 3 | 3 |
| Solicitor's Office | | 1 | 1 |
| Division of Accounts and Disbursements | 1 | | 1 |
| Fixed Nitrogen Research Laboratory | 1 | | 1 |
| Total | 1,332 | 227 | 1,559 |

During the year 537 bonds, 345 renewals, and 35 terminations of leases and contracts were prepared. In addition to the examination of the above-tabulated contracts for sufficiency as to execution, there were also examined 1,520 road-project contracts and 719 modifications or cancellations of road-project contracts for the same purpose.

Nineteen claims of balances due estates of deceased employees were examined and the necessary papers prepared for their payment and advice furnished administrative officers relative to the same.

In the collection of seed loans made by the department under the acts of Congress of 1921 and 1922 one of the assistants in the office

was detailed to Grand Forks, N. Dak., to aid the administrative officials of the department. This work involved a large volume of correspondence with attorneys, banks, and individuals and necessitated the rendering of many opinions and the preparation of numerous releases and other papers and the filing of claims in behalf of the Government in bankruptcy proceedings resorted to by numbers of borrowers.

Aid was given the advisory committee on finance and business methods in drafting orders and memoranda of the Secretary for the general administration of the department and to the office of inspection in the consideration of a number of claims for reimbursement for property lost or destroyed while being used for official work in the national forests.

Assistance was given the Interdepartmental Board of Contracts and Adjustments in the preparation of a standard form of lease for the use of the various departments and independent establishments of the Government and in the preparation of a tentative form of building and construction contract.

Compilation of laws applicable to the Department of Agriculture was completed and submitted to the Public Printer during the year. Editing of the printer's proof of the text, comprised in 680 pages, was completed and the preparation of an index was undertaken. The design of the work is to consolidate and present in a single volume all existing laws relating or applicable to the work of the department as a convenient source of reference for the officials of the department and others interested in its activities.

Release of several department employees charged with violation of traffic regulations of the District of Columbia was secured.

Members of this office frequently participated in hearings and conferences touching the various activities of the department. Notable among these were hearings accorded the representatives of the rosin and turpentine industry relative to the scope and character of the naval stores act, and conferences with the officials of certain railroads and of the Department of Justice relative to the settlement of 28-hour-law violations in which suits for the recovery of the statutory penalties had been instituted by the Government against the carriers. These conferences resulted in the payment into court of $149,300 by the carriers in settlement of the violations.

Conferences were also attended relative to the preparation of a bill authorizing the registration of certain seeds and for other purposes; the preparation of regulations governing the interstate transactions of naval stores; regulations governing meat inspection; and regulations under the cotton standards act, the grain futures law, the cotton futures act, the food products inspection law, the tea inspection act, and the plant quarantine act. Almost daily conferences were had with attorneys and shippers interested in goods seized under the provisions of section 10 of the food and drugs act and in criminal cases arising under that law. Numerous conferences were also had with attorneys and others interested in matters arising under the various other regulatory laws of the department.

Many regulations, orders, proclamations, forms, specifications, and schedules required in the administration of the various statutes committed to the department for enforcement were prepared or assistance given in their preparation. Among the more important of which may be mentioned regulations to carry into effect the grain

futures act; regulations under the cotton standards act and the food products inspection law; regulations governing the preparation, sale, barter, exchange, and shipment of viruses, serums, toxins, etc., and amendments thereto; regulations governing importation of pure-bred animals and amendments thereto; proclamations exempting certain countries from the prohibition of section 306, title 3, of the tariff act of 1922; regulations controlling the importation of domestic livestock and other animals; regulations providing for the appraisement of tuberculous animals; regulations governing meat inspection; regulations for the enforcement of the food and drugs act, the tea inspection act, and the United States warehouse act; the administration of the Center Market; amendments to the migratory bird treaty act regulations, and the regulations promulgated under the Alaska game law, the Alaska fur law, and the United States grain standards act; and numerous amendments to the fiscal and administrative regulations. Orders for the establishment of plant and animal quarantines and for the revocation and suspension of licenses of grain inspectors were examined as to their legal sufficiency. Aid was given the Bureau of Agricultural Economics in the preparation of cooperative agreements under the food products inspection law. Assistance was also given in the drafting of tentative regulations and the establishment of grades under the naval stores act.

Assistance was given in drafting the naval stores act (42 Stat. 1435); the act regulating the importation of the adult honeybee (42 Stat. 833); the grain futures act (42 Stat. 998); and the United States cotton standards act (42 Stat. 1517). Assistance was also rendered in the preparation of the department's reports upon various bills referred to it by committees of Congress having them in charge. Among the bills reported upon were a number affecting the national forests, one for promoting and encouraging agriculture by divesting grains of their interstate character in certain cases (H. R. 14167, Sixty-seventh Congress), another authorizing the registration of certain seed and for other purposes (S. 3880, Sixty-seventh Congress), another providing for the reimbursement of J. B. Glanville and others for losses and damages sustained by them through the shipping of cattle carrying the infection of splenetic fever from Texas into Kansas during the year 1919 (S. 854, Sixty-seventh Congress), and one authorizing arrests for violation of the laws applicable to the national forests and protecting national-forest officers in the execution of their duties (S. 3764, Sixty-seventh Congress).

Six claims involving damage to privately owned personal property resulting from alleged negligence of department employees were considered under the act of December 28, 1922.

Claims of the department in a number of cases were prepared and filed in bankruptcy proceedings pending in various sections of the United States.

Much time and attention were devoted to the very serious situation growing out of resistance to the tick-eradication work being conducted by the department in cooperation with the State of Georgia in the southern part of that State. This resistance culminated in the killing of one and the serious wounding of another of the department's employees. It seemed for a time that the guilty parties would entirely escape prosecution and certainly punishment. By cooperation with the United States attorney in that district and

through efforts of the Bureau of Investigation of the Department of Justice, there was a very encouraging prospect at the close of the fiscal year that proper action would be taken against the persons responsible for the killing and wounding of the department's employees and that conditions in that section of Georgia would hereafter conduce to a more satisfactory accomplishment of tick eradication.

Many papers of various kinds, including statements of issues, briefs, and memoranda on legal matters, were prepared at the request of the officials of this department for submission to the Attorney General, the Secretary of the Interior, the Comptroller General, and the officials of other departments. Also, many service and regulatory announcements, circulars, and bulletins, referred to this office for consideration from a legal aspect, were reviewed and comment made thereon.

Briefs and memoranda on legal questions were furnished in many of the cases reported to the Department of Justice for prosecution, and assistance was given in the trials of some of the cases. Among the important cases in which this office assisted, either in the preparation of the briefs or in the trials, or both, were United States *v.* R. E. Smith, United States *v.* Strange Bros. Hide Co., United States *v.* F. M. McGowan Co., United States *v.* William H. Gordin, United States *v.* S. E. Avery, United States *v.* Henry S. Horkheimer, all involving suits for the recovery of profits made by licensed wool dealers in excess of the rate of profits fixed by the War Industries Board; United States *v.* Ben Rosenbaum, Leon Rosenbaum, and Percy A. Matthews, a criminal prosecution based on the charge of conspiracy to defraud the Government; the Board of Trade of the City of Chicago et al. *v.* Olsen et al., a suit instituted to test the constitutionality of the grain futures act; United States *v.* John Dobry Manufacturing Co.; United States *v.* B. & M. External Remedy; United States *v.* Crab Orchard Mineral Water; United States *v.* 154 Sacks Oats; United States *v.* Southern Cotton Oil Co.; United States *v.* Sherer Gillett Co.; United States *v.* 200 Cases Canned Salmon; United States *v.* Crisifulli Bros.; A. O. Anderson Co. *v.* United States; Douglas Packing Co. *v.* United States; Duffy-Mott Co. *v.* United States; W. B. Wood Manufacturing Co. *v.* United States; United States *v.* Ninety-five Barrels Vinegar, More or Less, alleged apple-cider vinegar, all involving violations of the food and drugs act; United States *v.* W. E. Pierce, a case arising under the animal quarantine law; United States *v.* Terminal Railroad Association of St. Louis; United States *v.* East St. Louis Junction Railroad Co., involving suits under the 28-hour law; and United States *v.* Alexander Schaper, involving a suit to recover possession of a Center Market stand.

Forms of indictments and informations were prepared by this office in practically all of the criminal violations referred to the United States attorneys for prosecution under the regulatory laws of the department. Forms of complaints in all 28-hour law violations were likewise prepared in this office and transmitted to the United States attorneys on which to base suits against carriers to recover from them the penalties prescribed by that law. When feasible, libels were also prepared in seizure proceedings arising under section 10 of the food and drugs act and forwarded to the United States attorneys. The preparation of these pleadings not only materially aided the United States attorneys in handling the cases but greatly expedited their consideration by the courts.

In addition, testimony was taken by this office in several patent cases prosecuted on behalf of department employees in which interference proceedings had been declared by the Patent Office between their applications for patents and applications filed by outside parties. Briefs were also prepared and filed in these interferences and oral arguments made therein before the Patent Office.

## THE NATIONAL FORESTS.

During the year there were handled 331 claims to lands in the national forests based upon the homestead, mineral, railroad grant, lieu selection, and other general and special laws of the United States. Hearings in 36 land cases were attended by representatives of this office. Of 87 decisions rendered by the Interior Department closing cases, 60 decisions were favorable to the Government and resulted in the retention in the forests of considerable land and timber.

Other work for the Forest Service included handling the following cases and other business:

| | | | |
|---|---|---|---|
| Claims to lands (pending during year) | 331 | Court appearances | 21 |
| Hearings attended | 36 | Written opinions | 342 |
| Depositions taken | 1 | Trespasses: | |
| Briefs prepared and filed | 15 | Grazing | 218 |
| Appeals to Secretary, and briefs | 15 | Timber | 26 |
| General litigation | 41 | Fire | 117 |
| Contracts, leases, etc | 1,062 | Occupancy | 21 |
| Bills, complaints, informations, protests, etc | 121 | Property | 15 |

*Trespass cases on the national forests.*

| Character of trespass. | Number. | Damages. | Fines. |
|---|---|---|---|
| Grazing | 107 | $14,708.23 | $822.20 |
| Timber | 12 | 3,564.40 | |
| Fire | 39 | 10,604.18 | 475.00 |
| Property | 2 | | 38.65 |
| Occupancy | 1 | | 20.00 |
| Total | 161 | 28,876.81 | 1,355.85 |

## COURT DECISIONS OF INTEREST.

The case of Curtis, Collins & Holbrook Co. *v.* United States (262 U. S. 215) involved lands most of which are in the Plumas National Forest, covered by 24 timber and stone entries patented in 1902. Suits to vacate the patents were instituted on the grounds (1) that the entrymen swore falsely that they were applying for the lands for their own benefit, whereas, before making application, they had agreed to convey the lands entered to the Curtis, Collins & Holbrook Co., and (2) that the company knew of the fraud and procured the entrymen to make the entries for its benefit. The defense of bona fide purchaser was relied upon. The United States District Court for the Northern District of California found for the defendants and dismissed the bill. Upon appeal, however, the decision of the district court was reversed by the Circuit Court of Appeals. The action of the latter court was affirmed by the Supreme Court of the United States on May 21, 1923. Those of the lands within the national forest became a part thereof immediately upon the vacation of the patents.

In a case of unusual interest, especially to this department (United States *v.* Sherman, 288 Fed. 497), the Circuit Court of Appeals for the Eighth Circuit held that a State statute may enlarge the requirements prescribed by the Federal law for the location of mining claims, and that failure by the mineral locator to comply with such additional requirements of the State statute renders his mining location invalid. This case arose by reason of a conflict between a Forest Service timber sale and two mining locations. The statute of South Dakota required the location certificate to contain a description "by reference to some natural object or permanent monument as will identify the claim," and also that the surface boundaries be marked by substantial posts. The court of appeals, reversing the lower court, held the location invalid for failure to comply with both of these requirements. This is the first known instance in which a Federal court has held a mining location to be invalid against the Government for failure to comply with the requirements of State statutes when not included in the Federal mining laws.

In a suit between private parties (McFall *v.* Arkoosh, 215 Pac. 978), involving the regulations of this department governing grazing on the national forests, the Supreme Court of Idaho held that in view of the Federal regulation prohibiting the transfer of permits damages could not be recovered against a stockman for his failure to comply with his agreement to transfer his permit with cattle he had sold.

In United States *v.* Taylor and Wyman, it was held by the United States District Court for Montana in a decree dated October 16, 1922, that possession of national forest land under a special-use permit is exclusive and superior to possession under a subsequent mill-site location. The claimants of the mill-site location were therefore enjoined from interfering with possession under the permit.

## WEEKS FORESTRY LAW (36 Stat. 961).

The work of examining titles to lands acquired under the Weeks forestry law has progressed as rapidly as the surveys of the large tracts were completed by the forest service and the difficulties of clearing defects in titles would permit.

During the year the National Forest Reservation Commission has held two meetings, at which it approved the purchase of various tracts of land comprising approximately 80,000 acres that were offered for sale to the Government by 113 owners. Two hundred and five agreements covering the purchase of land under the Weeks forestry law were prepared.

The following is a summary, in terms of acres, of the operations under the Weeks forestry law during the fiscal year:

| State. | Acreage acquired, 1923. | Acreage in condemnation. | Title examined, acquisition pending. | Acreage to be acquired. |
|---|---|---|---|---|
| Alabama | 16,187 | 919.13 | 1,682 | 4,462 |
| Arkansas | 13,155 | 2,530.28 | 2,230 | 4,762 |
| Georgia | 8,791 | 2,381.52 | 3,280 | 6,314 |
| Maine | 92 | | | |
| New Hampshire | 738 | 1,460.42 | 1,820 | 3,380 |
| North Carolina | 25,209 | 1,021.67 | 2,816 | 5,215 |
| Pennsylvania | | 1,221.15 | 46,320 | 108,886 |
| South Carolina | 104 | | | 603 |
| Tennessee | 831 | 2,616.04 | 18,560 | 27,485 |
| Virginia | 65,573 | 30,733.[illegible] | 29,172 | 69,156 |
| West Virginia | 28,650 | 45,882.[illegible] | 16,200 | 79.741 |
| Total | 159,330 | 88,766.50 | 122,080 | 310,004 |

## THE FOOD AND DRUGS ACT (34 Stat. 768).

Eight hundred and eighty-five cases were transmitted to the Department of Justice, 190 for criminal prosecutions and 695 for seizures. The 190 criminal cases embraced 443 alleged violations of the food and drugs act.

Four hundred and forty-eight civil cases pending at the close of the fiscal year 1921 and 356 reported during the fiscal year 1922, in all 804 civil cases, were terminated in 1922. One hundred and eleven criminal cases pending at the close of the fiscal year 1921, and 126 reported during the past year, in all 237 criminal cases were terminated in 1922. The total number of cases terminated during the year both civil and criminal were 1,041.

In 192 of the 237 criminal cases terminated during the year, fines were imposed or collateral forfeited. In 186 of these cases, pleas of guilty, nolo contendere, etc., were entered. In 4 of them fines were imposed after trial and conviction and in 2 collateral that had been deposited by defendants was forfeited by reason of their nonappearance in court. In 3 the defendants were found not guilty after trial, and 42 cases were nolle prossed or the information dismissed.

*Fines imposed in criminal cases (exclusive of costs which were generally assessed).*

| Number of cases. | Amount of fine. | Total. | Number of cases. | Amount of fine. | Total. |
|---|---|---|---|---|---|
| 1 | $1 | $1 | 5 | $75 | $375 |
| 1 | 2 | 2 | 33 | 100 | 3,300 |
| 1 | 3 | 3 | 1 | 101 | 101 |
| 3 | 5 | 15 | 1 | 140 | 140 |
| 1 | 6 | 6 | 6 | 150 | 900 |
| 12 | 10 | 120 | 1 | 170 | 170 |
| 1 | 11 | 11 | 16 | 200 | 3,200 |
| 4 | 15 | 60 | 2 | 300 | 600 |
| 2 | 20 | 40 | 2 | 450 | 900 |
| 34 | 25 | 850 | 2 | 500 | 1,000 |
| 3 | 40 | 120 | 1 | 600 | 600 |
| 52 | 50 | 2,600 | 2 | 1,000 | 2,000 |
| 3 | 51 | 153 | | | |
| 1 | 60 | 60 | 191 | ..... | 17,327 |

Of the 787 civil cases terminated during the year, decrees of condemnation and forfeiture or informal orders for the disposition of the property were entered in 737, in 46 the libels were either dismissed or the product disposed of before actual seizure could be consummated, in 2 verdicts were returned for the claimant after trial, and in 2 the product was released on bond without the entry of a decree. Five of the foregoing cases were contested, 3 resulting in verdicts for the Government and 2 for the claimants.

At the close of the year 825 cases were pending, of which 232 were criminal prosecutions and 593 were seizures.

In addition to the cases reported by this department to the Department of Justice, the food and drugs officials of the various States and the District of Columbia, collaborating with the department in the enforcement of the act, are shown by the records of this office to have reported 34 cases to the United States attorneys, 24 of which were terminated during the year. Of these, 25 were criminal cases and 9 were seizures. In 22 of the criminal cases terminated there

were pleas of guilty or nolo contendere, or the collateral desposited by defendants was forfeited on account of nonappearance. In one of the seizure cases a default decree was entered and in the other a consent decree was entered and the product taken down under bond.

*Fines in food and drug cases begun by United States attorneys on reports of State authorities.*

| Number of cases. | Amount of fine. | Total. |
|---|---|---|
| 1 | $10 | $10 |
| 14 | 25 | 350 |
| 3 | 50 | 150 |
| 4 | 100 | 400 |
| 22 | ..... | 910 |

One thousand and fifty notices of judgment were prepared and published during the year.

### COURT DECISIONS OF INTEREST.

The case of A. O. Anderson & Co. *v.* United States (284 Fed. Rep. 542) was the outgrowth of a seizure proceeding against a shipment of canned salmon, the lower court having directed a verdict for the claimant on the ground that the "article" of the statute referred to the individual cans and not to the product or shipment as a whole, and that to condemn the entire shipment each can must be found to be adulterated. The Circuit Court of Appeals for the Ninth Circuit, in reversing the lower court, held that in the provisions of the food and drugs act covering the seizure and condemnation of "any article of food" which is adulterated or misbranded, the word "article" is used in a broad and comprehensive sense, and as applied to a shipment of a food product in containers, such as canned salmon, it has reference to the shipment as a whole, and therefore to authorize condemnation of the product under the act it is not necessary for the Government to prove that each individual can is adulterated. The court also held that in proceedings under the act for condemnation of adulterated food, proof that the food product was injurious to health was not required, and that the act was not invalid because it failed definitely to specify the extent to which decomposition must have progressed to bring the article within the prohibition.

The case of Duffy-Mott Company *v.* United States (285 Fed. Rep. 737) was based on a seizure proceeding instituted against a shipment of artificially carbonated apple juice flavored with capsicum and labeled "Sparkling White Seal." The libel alleged that the product was adulterated and misbranded. At the trial in the lower court the Government abandoned the adulteration charge and stood on the single misbranded charge that the package containing the article and its label bearing the statement "Sparkling White Seal," together with the general design and appearance of the bottled product, were misleading to the purchaser in that it simulated "White Seal Champagne." The court instructed the jury that a bottler of a beverage has the right, as far as the food and drugs act is concerned, to use any name on his product that suits his fancy, unless the name on the label

itself or its use in association with the shape of the bottle or the manner in which the article is put up is such as to mislead the public into thinking that the article is something else than it is. The Circuit Court of Appeals for the Third Circuit affirmed the verdict for the Government in the lower court, holding that evidence as to resemblance between the bottles and labels of "Sparkling White Seal" and those used for champagne sold under the same name raised a question of fact for the jury.

In the case of United States *v.* Ninety-five Barrels, More or Less, Alleged Apple Cider Vinegar, F. and D. No. 12068, the Circuit Court of Appeals for the Sixth Circuit reversed the judgment of the District Court for the Northern District of Ohio, which held that vinegar derived from evaporated apple products is misbranded if labeled "Apple Cider Vinegar." The Government moved for a rehearing in the case, but its motion was denied. Thereupon the department recommended to the Attorney General that application be made to the Supreme Court for a writ of certiorari to review the decision of the appellate court. The Attorney General has concurred in the department's recommendation, and proceedings looking to a review of the case will be instituted when the Supreme Court convenes for its October term.

The case of United States *v.* Two Hundred Cases, More or Less, of Canned Salmon (289 Fed. Rep. 157) was a seizure action in the district court for the condemnation of canned salmon on the ground that the product was misbranded and adulterated. The court entered a decree condemning the product on the misbranding count, since the label bore the statements "select" and "fresh fish," when the pack was shown to be of inferior quality and not fresh, as that term is understood by the trade. The court also held that the word "article," as used in the act, applies to the food itself, and not to the case or package in and by means of which the shipment is effected, and that it was not necessary for the Government to prove that the product was unfit for food or deleterious if eaten.

The case of United States *v.* 154 Sacks of Oats (283 Fed. Rep. 985) was a seizure proceeding against a quantity of oats, and the court in deciding the issues in favor of the Government on an agreed statement of fact held that where oats shipped in interstate commerce contained 23 per cent of foreign material, a percentage of which was commercial wild oats which had been intentionally added, they were subject to forfeiture under the food and drugs act.

The case of United States *v.* Loft (Inc.), F. and D. No. 15995, was a criminal proceeding under the net weight amendment to the food and drugs act. The information filed therein charged that the statement, "This package Weighs One Pound. This Specified Weight Includes the Container. 2 oz.," appearing on the label was not a plain and conspicuous marking of the quantity of the contents. The defendant corporation demurred to the information, and the court sustained the demurrer on the ground that the branding was a substantial compliance with the law, although it did require a problem in subtraction to ascertain the contents of the package, the problem being of such a simple nature that it could be performed by any person who could read.

The case of United States *v.* 11 Packages B. and M. External Remedy, F. and D. No. 11492, was a seizure proceeding against a proprietory medicine recommended as an external remedy for

numerous diseases, such as tuberculosis, pneumonia, peritonitis, locomotor ataxia, diphtheria, and infantile paralysis. The libel charged that certain of the statements on the label and circular were false and fraudulent. Although the Government was able to introduce convincing testimony to the effect that the product was not a cure or remedy for the diseases named, it was unable to establish the element of fraud by a preponderance of the evidence and a verdict was returned by the jury for the claimants.

The case of United States *v.* Southern Cotton Oil Co., F. and D. No. 10764, was based on a criminal information charging a violation of the net weight amendment to the food and drugs act in that the cans for its product known as "Wesson oil" were not correctly marked as to the quantity of their contents. The defendant corporation contended that the shortage in weight established by Government's evidence was a reasonable variation within the scope of the proviso in the act. In instructing the jury the court charged that it was a question of fact for the jury whether the variations shown were "reasonable variations" within the terms of the act. The court held that the rules and regulations of the department respecting variations and tolerances were within the terms of the act and were as binding as the act of Congress under which they were issued, and that the cans containing the article were not "small packages" under the terms of the regulations.

The case of United States *v.* John Dobry Manufacturing Co., F. and D. No. 15069, was a criminal prosecution under the Sherley amendment. The information charged that the remedy known as "Dobry's Positive Cure for Hog Diseases" was misbranded in that the therapeutic and curative statements on the label of the article were false and fraudulent. The label bore statements to the effect that the compound was a preventive and positive cure for hog cholera and tuberculosis and other enumerated diseases. At the trial of the case in the district court, the Government was able to prove that the compound would not prevent or cure the diseases named; and further, that the product had been shipped by the defendant corporation after official tests had been made by the Indiana State Experiment Station at Purdue on hogs actually exposed to cholera, and after the company had been notified by the Indiana authorities of the inefficacy of the medicine. The element of fraud was thus established and the jury returned a verdict of guilty.

The case of United States *v.* Sutherland Flour Mills Co., F. and D. No. 15453, N. J. No. 11382, was based on a criminal information charging adulteration and misbranding of "Wheat Shorts with Mill Run Ground Screenings." The case was tried before the court without a jury, and after the submission of the evidence the court found the defendant corporation guilty of adulteration of the article in that reground bran had been substituted for the article and of misbranding in that the article was a product composed wholly or in part of reground bran and was an imitation of and offered for sale under the distinctive name of another article.

The case of United States *v.* 22 Bottles of Crab Orchard Concentrated Mineral Water, F. and D. No. 15395, was a seizure proceeding against a mineral water under the Sherley amendment, the label complained of bearing certain objectionable therapeutic claims. A previous case had been tried in the same court on another label and the

manufacturer refused to delete certain diseases from the new label which were declared objectionable by the former verdict for the Government. The element of fraud was established by reason of the apparent persistence of the manufacturer after the former verdict, and the jury returned a verdict for the Government. Steps have been taken by the defendant corporation to have the case reviewed by the Circuit Court of Appeals.

The case of United States *v.* Sherer-Gillett Co., F. and D. No. 12314, N. J. No. 11450, was a criminal action charging adulteration and misbranding of "Lemon Pie Filling" and "Orange Pie Filling" prepared and sold by the defendant and was tried to a jury. Adulteration was alleged for the reason that cornstarch and tartaric acid, flavored with lemon or orange oil had been mixed and packed with and substituted in part for pie filling. The misbranding charge was predicated on the statements "Orange Pie Filling," "Lemon Pie Filling," and "Contains in concentrated form the same ingredients used by the housewife in making Lemon (or Orange) Pie." The adulteration charge was dismissed at the trial of the case, and the jury returned a verdict of guilty as to the misbranding charge.

The case of The Newton Tea & Spice Co. *v.* United States, F. and D. No. 11048, was based on a criminal action (275 Fed. Rep. 394), in which a verdict of guilty was found in the district court on an information charging that the label of a powder sold as "Eggno" and composed of commercial egg albumen and egg yolk, evaporated skim milk, tapioca starch, powdered sugar, vegetable gum, salt, and artificial coal-tar color contained certain false and misleading statements. The statements complained of were: "To be used in place of eggs in baking and cooking," "An excellent substitute for eggs," "To be used for baking and cooking purposes," "Eggno contains the constituents that cause fresh eggs to fill such an important place," and "One even teaspoonful is to be used in place of each egg called for in recipes," etc. The Circuit Court of Appeals for the Sixth Circuit, in affirming the judgment of the lower court, sustained the lower court in overruling a motion by the defendant to direct a verdict, based on the contention that, as a matter of law, the comparative nutritive values of Eggno and eggs should not be taken into account. The lower court's action in allowing the jury to find as facts whether the statements on the label were equivalent to an assertion that one teaspoonful of Eggno was equal to an egg in a recipe; whether Eggno contained the constituents which cause fresh eggs to fill such an important place in the kitchen; and whether Eggno was a substitute for eggs, was affirmed. The court also held that there was no merit in the contention of plaintiff in error that the statement on the label that Eggno is an excellent substitute for eggs and is to be used for baking and cooking purposes, is merely one of opinion, since those statements passed beyond mere commendation and were statements of fact, and therefore did not fall within the rule announced in the case of United States *v.* Johnson (221 U. S. 488, 489).

## THE INSECTICIDE ACT OF 1910 (36 Stat. 331).

Fifty-one cases were reported to the Attorney General during the fiscal year ending June 30, 1923, in 45 of which, involving 49 violations, criminal proceedings were recommended, and in 6 of which seizures were recommended. At the close of the fiscal year ended June 30, 1922, 111 cases were pending, 106 of which were criminal prosecutions and 5 of which were civil, or seizure, cases.

Fifty-six cases pending at the close of the fiscal year ended June 30, 1922, and 21 cases reported during the fiscal year ended June 30, 1923, in all 77 cases, were terminated during the year. Of the cases terminated, 69 were criminal and 8 were civil cases. Of the 69 criminal cases, 2 were ordered placed "on file," without fines, after pleas of nolo contendere, fines were imposed in 55, and 12 were dropped or dismissed. Pleas of "guilty" were entered in 42 cases, pleas of nolo contendere were entered in 14 cases, and a jury verdict of "guilty" was rendered in 1 case.

In the criminal cases in which convictions were obtained, the fines were as follows:

| Number of cases. | Amount of fine. | Total. | Number of cases. | Amount of fine. | Total. |
|---|---|---|---|---|---|
| 2 | $1 | $2 | 1 | $50 | $50 |
| 4 | 5 | 20 | 5 | 100 | 500 |
| 6 | 10 | 60 | 3 | 200 | 600 |
| 11 | 20 | 220 | 1 | 300 | 300 |
| 20 | 25 | 500 | | | |
| 1 | 30 | 30 | 55 | ..... | 2,322 |
| 1 | 40 | 40 | | | |

Court costs were assessed in the greater number of cases in which convictions were obtained. Decrees of condemnation and forfeiture were entered in 8 civil or seizure cases, in 4 of which the goods were released under bond, in 3 the goods were destroyed, and in 1 the goods were ordered to be sold by the United States marshal. There were 100 notices of judgment prepared and published under section 4 of the act.

## MEAT INSPECTION ACT (34 Stat. 1260).

Thirty-six cases were reported to the Attorney General for prosecution under this act. Of these, 13 were terminated by fines, as follows: One, $100; three, $50 each; three, $30 each; one, $25; three, $10 each; and two, $1 each. Four cases were dismissed.

Of the cases pending at the close of the fiscal year 1922, 15 were terminated by fines, as follows: One, $250; one, $150; two, $100 each; two, $50 each; one, $37.50; three, $25 each; three, $20 each; and two, $10 each. Thirteen cases were nolle prossed. One case was terminated by judgment against defendant for the payment of costs, $82.05. Fines aggregating $1,289.50 were imposed in the 28 cases, as follows:

*Fines imposed in meat-inspection cases.*

| Number of cases. | Fines. | Total. | Number of cases. | Fines. | Total. |
|---|---|---|---|---|---|
| 1 | $250.00 | $250.00 | 4 | $25.00 | $100.00 |
| 1 | 150.00 | 150.00 | 3 | 20.00 | 60.00 |
| 3 | 100.00 | 300.00 | 5 | 10.00 | 50.00 |
| 5 | 50.00 | 250.00 | 2 | 1.00 | 2.00 |
| 1 | 37.50 | 37.50 | | | |
| 3 | 30.00 | 90.00 | 28 | ..... | 1,289.50 |

## TWENTY-EIGHT HOUR LAW (34 Stat. 607).

Five hundred and ninety-five cases were reported to the Attorney General for action during the fiscal year.

Two thousand one hundred and twelve cases were closed during the fiscal year, 1,708 of which were terminated by the imposition of penalties, 279 were terminated by dismissal, 126 were barred by the statute of limitations, and in 10 verdicts were rendered in favor of the defendant.

During the year penalties aggregating $171,300 were collected in 1,708 cases.

Following is a detailed table of the number of cases prosecuted and the amounts of penalties assessed:

*Cases prosecuted and penalties imposed under the 28-hour law.*

| Number of cases. | Penalty. | Total amount. |
|---|---|---|
| 1,703 | $100 | $170,300 |
| 5 | 200 | 1,000 |
| 1,708 | ..... | 171,300 |

A number of conferences between attorneys for certain railroads and the officials of the Department of Justice were participated in for the purpose of effecting amicable settlements of suits brought against such railroads for violating the 28-hour law. These conferences resulted in securing, among others, settlement of 876 cases against the Pennsylvania Railroad Co. by the confession of judgment and the payment of a penalty of $100 in each case, amounting in all to $87,600; the settlement of 527 cases against the New York Central Railroad Co. by the confession of judgment and the payment of a penalty of $100 in each case, amounting in all to $52,700; the settlement of 50 cases against the New York, Chicago & St. Louis Railroad Co. by the confession of judgment and the payment of a penalty of $100 in each case, amounting in all to $5,000; the settlement of 18 cases against the Michigan Central Railroad Co. by the confession of judgment and the payment of a penalty of $100 in each case, amounting in all to $1,800; the settlement of 13 cases against the Grand Trunk Railway system by the confession of judgment and the payment of a penalty of $100 in each case, amounting in all to $1,300; and the settlement of 9 cases against the Wabash Railway Co. by the confession of judgment and the payment of a penalty of $100 in each case, amounting in all to $900.

**ACTS RELATING TO THE INTERSTATE MOVEMENT OF LIVESTOCK FROM QUARANTINED DISTRICTS, PROHIBITING THE INTERSTATE MOVEMENT OF DISEASED LIVESTOCK, AND PROHIBITING THE IMPORTATION OF DISEASED LIVESTOCK (23 Stat. 31; 26 Stat. 414; 32 Stat. 791; 33 Stat. 1264).**

Five cases involving violations of the act of May 29, 1884 (23 Stat. 31), were reported to the Attorney General for prosecution. Of these, 1 was terminated by a fine of $100, and 1 by a fine of $100 and costs. In one case the defendant was found guilty and sentenced to one day in the custody of the United States marshal. Of the cases pending at the close of the fiscal year 1922, 1 was terminated by a fine of $400, 4 by a fine of $300 each, 7 by a fine of $200 each, 2 by a fine of $100 and costs each, 11 by a fine of $100 each, and 1 by a fine of $10; 8 cases were dismissed and 1 was nolle prossed.

Forty-seven cases were reported to the Attorney General for prosecution under the act of February 2, 1903 (32 Stat. 791), of which six were terminated by a fine of $100 and costs and four by fines of $100, $50, $25, and $10, respectively. Two cases were dismissed, and in each of two cases reported for prosecution by indictment the grand jury returned a verdict of "no true bill." Of the cases pending at the close of the fiscal year 1922, 13 were terminated by a fine of $100 and costs each, 27 by a fine of $100 each, and 1 by a fine of $200; 1 case was nolle prossed, 4 were dismissed, and in each of 6 cases reported for prosecution by indictment the grand jury returned a verdict of "no true bill."

Twenty-eight cases were reported to the Attorney General charging a violation of the act of March 3, 1905 (33 Stat. 1264), of which five were terminated by a fine of $100 each and four by fines of $200, $200 and costs, $100 and costs, and $1, respectively. In each of three cases reported for prosecution by indictment, the grand jury returned a verdict of "no true bill." Of the cases pending at the close of the fiscal year 1922, 18 were terminated by a fine of $100 each, 9 by a fine of $100 and costs each, 1 by a fine of $150 and costs, and 1 by a fine of $50; 1 case was terminated by a verdict of "not guilty," 4 were dismissed, 2 were nolle prossed, and the prosecution of 1 was barred by the statute of limitations.

In all, 80 cases under the animal quarantine laws were reported to the Department of Justice.

| Number of cases. | Fines. | Total. | Number of cases. | Fines. | Total. |
|---|---|---|---|---|---|
| 1 | $1 | $1 | 10 | $200 | $2,000 |
| 2 | 10 | 20 | 4 | 300 | 1,200 |
| 1 | 25 | 25 | 1 | 400 | 400 |
| 2 | 50 | 100 | | | |
| 95 | 100 | 9,500 | 117 | ..... | 13,396 |
| 1 | 150 | 150 | | | |

In each of the cases reported to the Attorney General for prosecution under the acts of May 29, 1884, February 2, 1903, and March 3, 1905, a suggested form of indictment or criminal information was prepared and submitted therewith for use by the United States attorneys.

## THE MIGRATORY BIRD TREATY ACT (40 Stat. 755).

Four hundred and ninety-two cases were reported to the Department of Justice.

*Fines imposed under the migratory bird treaty act.*

| Number of cases. | Amount of fines. | Total. | Number of cases. | Amount of fines. | Total. |
|---|---|---|---|---|---|
| 2 | Costs. | ..... | 1 | $7.00 | $7.00 |
| 1 | $0.01 | $0.01 | 128 | 10.00 | 1,280.00 |
| 47 | 1.00 | 47.00 | 82 | 25.00 | 2,050.00 |
| 1 | 12.50 | 12.50 | 1 | 27.00 | 27.00 |
| 23 | 15.00 | 345.00 | 1 | 40.00 | 40.00 |
| 21 | 20.00 | 420.00 | 16 | 50.00 | 800.00 |
| 1 | 2.00 | 2.00 | 13 | 100.00 | 1,300.00 |
| 3 | 2.50 | 7.50 | 1 | 125.00 | 125.00 |
| 1 | 3.00 | 3.00 | 1 | 250.00 | 250.00 |
| 2 | 4.00 | 8.00 | | | |
| 72 | 5.00 | 360.00 | 418 | ..... | 7,084.01 |

In several cases defendants were sentenced to jail for terms ranging from six days to five months. Defendants were acquitted in 13 cases.

## THE LACEY ACT (35 Stat. 1137).

Five cases were reported to the Department of Justice.

*Fines imposed under the Lacey Act.*

| Number of cases. | Amount of fines. | Total. |
|---|---|---|
| 1 | $25 | $25 |
| 1 | 50 | 50 |
| 2 | 75 | 150 |
| 4 | ..... | 225 |

## PISGAH GAME PRESERVE LAW (39 Stat. 476).

Five cases were reported to the Department of Justice.

*Fines imposed under the Pisgah game preserve law.*

| Number of cases. | Amount of fines. | Total. |
|---|---|---|
| 2 | $25 | $50 |
| 1 | 50 | 50 |
| ..... | ..... | 100 |

## NATIONAL FOREST GAME REGULATIONS (Regulation T-1).

Sixty-one cases involving hunting and fishing on national forests in violation of State laws were reported. Of these, 58 were closed, 55 by conviction and the imposition of fines, 2 by verdict of not guilty, and 1 by dismissal. In 3 cases jail sentences of 30 days each were imposed in addition to fines.

*Fines imposed in cases involving game violations on national forests.*

| Number of cases. | Amount of fines. | Total. | Number of cases. | Amount of fines. | Total. |
|---|---|---|---|---|---|
| 2 | $10.00 | $20.00 | 1 | $40.00 | $40.00 |
| 28 | 25.00 | 700.00 | 1 | 50.00 | 50.00 |
| 4 | 27.50 | 110.00 | 1 | 55.00 | 55.00 |
| 2 | 28.00 | 56.00 | 1 | 77.20 | 77.20 |
| 6 | 28.50 | 171.00 | 1 | 84.70 | 84.70 |
| 1 | 29.00 | 29.00 | 1 | 87.50 | 87.50 |
| 2 | 32.50 | 65.00 | 1 | 163.00 | 163.00 |
| 1 | 37.00 | 37.00 | | | |
| 2 | 39.00 | 78.00 | 55 | ..... | 1,823.40 |

## UNITED STATES GRAIN STANDARDS ACT (39 Stat. 482).

Consideration was given to the suspension and cancellation of a number of licenses issued under the act.

The evidence introduced at hearings in eight cases involving violations of section 5 of the act was examined. In six of these findings of fact were prepared and published. Two of the cases were returned to the Bureau of Agricultural Economics with the suggestion that the facts relating thereto be not published.

Reports of the bureau in six cases involving the violation of section 4 of the act were considered, and, together with forms of information prepared, were referred to the Attorney General with recommendations that criminal proceedings be instituted. Five of the cases were successfully concluded and the defendants fined in sums aggregating $400. The remaining case is pending.

Opinions were rendered on questions arising under the act and assistance was given the bureau in drafting amendments to the regulations promulgated thereunder.

## THE GRAIN FUTURES ACT (42 Stat. 998).

On September 21, 1922, Congress passed "the grain futures act," the purpose of which, as expressed in its title, is the prevention of obstructions and burdens upon interstate commerce in grain by regulating transactions on grain futures exchanges. This act was passed to take the place of "the futures trading act" of August 24, 1921, declared unconstitutional by the Supreme Court on May 15, 1922, in Hill *v.* Wallace (259 U. S. 44). The futures trading act was based upon the taxing power of Congress. The court held that it was not passed for the purpose of raising revenue, but for the regulation of the grain exchanges, and was therefore unconstitutional.

The new act, in the drafting of which this office assisted, is based upon the power of Congress over interstate commerce. In due time suits were filed by the principal grain exchanges to test its constitutionality. The one filed by the Chicago Board of Trade was decided by the Supreme Court on April 16, 1923. The court upheld the validity of the act. The Government's answer, which was filed by the United States attorney in the district court, and a brief which the Solicitor General of the United States filed as an appendix to his brief before the Supreme Court, were prepared in this office in cooperation with the attorney for the Packers and Stockyards Administration. The applications of the several grain exchanges dealing in futures for designation as "contract markets" under the act were

examined for the purpose of ascertaining whether such exchanges had met the requirements of the act.

The regulations for carrying out the act were reviewed as to their legality and necessary modifications suggested.

**UNITED STATES WAREHOUSE ACT (39 Stat. 486; 41 Stat. 266; 42 Stat. 1282).**

There has been considerable activity under the warehouse act during the last fiscal year. The amendment of the act of February 23, 1923, necessitated the preparation of new bond and license forms. Various other forms were prepared in special cases under State and Federal laws. Five hundred bonds submitted in connection with applications for warehouse licenses were examined and action taken to cure such defects as rendered them doubtful of enforcement. Revised regulations for cotton warehouses were reviewed in this office.

**PACKERS AND STOCKYARDS ACT (42 Stat. 159).**

An attorney from this office was assigned to assist the attorney for the Packers and Stockyards Administration in the Armour-Morris merger case. Other matters arising in the administration of the act have been referred to this office for consideration and advice.

**FOOD PRODUCTS INSPECTION LAW (42 Stat. 507, 532).**

The inspection service authorized by this law was extended to additional products during the year by the Bureau of Agricultural Economics. Assistance was given the bureau in the preparation of cooperative agreements and regulations necessary to effect the additional service thus provided. Several claims for inspection charges due under this law were prepared and filed in bankruptcy proceedings.

**COTTON FUTURES ACT (39 Stat. 476).**

Amendments to the regulations and a revision of the cotton standards promulgated under the act were reviewed as to their legal sufficiency. In a suit between private parties (Brown *v.* Thorne, 260 U. S. 137), which was removed to the Supreme Court of the United States, that court held that section 4 of the act does not require that a memorandum of sale be signed by both parties, but is sufficient if signed by the party against whom demand is made. It was argued that the act was unconstitutional in view of the decision (Hill *v.* Wallace, 259 U. S. 44), holding the future trading act invalid, but the court did not pass upon that question.

**FEDERAL WATER POWER ACT (41 Stat. 1063).**

A number of opinions, prepared by the chief counsel of the Federal Power Commission on legal questions arising in the administration of the Federal water power act, submitted to this department for consideration, were carefully examined and returned with appropriate comment.

### THE UNITED STATES COTTON STANDARDS ACT (42 Stat. 1517).

Regulations prepared by the Bureau of Agricultural Economics, under the United States cotton standards act, were reviewed and suggestions made as to their legal sufficiency.

Soon after the act was passed the question arose as to whether it would apply to shipments of cotton made after August 1 in fulfillment of contracts made prior to March 1 and to contracts made after March 1 but prior to August 1. The question was submitted to the Attorney General for an opinion, and he advised that all shipments made on and after August 1 are subject to the act, regardless of when the contract was made.

### CAPPER-VOLSTEAD COOPERATIVE MARKETING ACT (42 Stat. 388).

A number of inquiries, oral and written, respecting the scope and effect of the act were answered.

### FEDERAL HIGHWAY ACT (42 Stat. 212).

Project statements for 1,282 projects were reviewed during the year to determine whether the projects were eligible for Federal aid. Of these, 1,278 were approved and 4 disapproved. The 1,278 projects which were approved involved a total estimated expenditure of $173,995,084.86 and Federal aid in the amount of $79,461,548.41 and 8,284.9 miles of road.

During the fiscal year project agreements and certificates of approval of plans, specifications, and estimates prepared by the Bureau of Public Roads involving 1,447 projects were reviewed as to their legal form and sufficiency, and also as to the sufficiency of their execution by the State highway departments in cases where such papers have been executed by the State authorities before submission to the department. Altogether, these agreements involved 9,805.2 miles of road and a total estimated expenditure of $189,223,126.14 and Federal aid aggregating about $87,040,043.51.

Drafts of 719 modifications or cancellations of project agreements and certificates, prepared by the Bureau of Public Roads and executed by the State highway departments or for signature by the Secretary before submission to the States, were similarly reviewed.

In addition to the above, there were reviewed as to legal form and substance 73 original agreements for the construction of roads within or partly within the national forests, under the provisions of section 23 of the Federal highway act.

#### IMPORTANT OPINION INVOLVING THE ADMINISTRATION OF THE FEDERAL HIGHWAY ACT.

On June 23, the Acting Attorney General, in response to the request of this department, rendered an opinion involving the title to and disposition of certain classes of the war materials, equipment, and supplies distributed among the States under section 5 of the act.

This opinion held that the title to such road-building equipment passed to the State, subject to the obligation to use it on Federal-aid roads, and that such material becoming unserviceable for road construction work might be sold or exchanged, with the obligation to use the receipts either in the purchase of other equipment to be used

on like roads or in other ways in construction work thereon. This was the holding with respect to road-building material which was found to be unserviceable (*a*) because it was in such condition when delivered, (*b*) because not usable in a reasonable time owing to changes in the State's road plans subsequent to the request for and delivery of the equipment, and (*c*) because worn out in road construction use. It was held, however, that a different situation existed as to equipment found to be unserviceable because, owing to mistakes in packing or in the inventory thereof, it was in itself unsuitable for road-building work. As to equipment of this kind, it was held that the title thereto was still in the United States, the State holding it merely as gratuitous bailee, and that such equipment should either be reshipped to some officer of the United States where it could be used profitably, or in cases where it might not be so shipped profitably, it might be disposed of for the account of the United States, and that the "proceeds" (R. S. 3618) of such sale to be forwarded to the department would be the selling price of the equipment, less prior freight charges thereon paid by the State.

### PLANT QUARANTINE ACT (37 Stat. 315).

During the year 63 cases were reported to the Attorney General for prosecution under the plant quarantine act of August 20, 1912, as amended by the act of March 4, 1917 (39 Stat. 1165). Of these 63 cases, 33 have been closed during the year by the imposition of fines. At the close of the fiscal year 1922 there were 40 cases pending, 22 of which have been closed by the imposition of fines and 11 by dismissal, nolle prosequi, etc. The record of the fines imposed in the 55 cases is as follows:

| Number of cases. | Amount of fine. | Total. |
|---|---|---|
| 1 | $1 | $1 |
| 3 | 5 | 15 |
| 14 | 10 | 140 |
| 4 | 20 | 80 |
| 22 | 25 | 550 |
| 10 | 50 | 500 |
| 1 | 75 | 75 |
| 55 | ..... | 1,361 |

The total number of cases still pending is 37, made up of 7 of those pending at the beginning of the present fiscal year and 30 of those submitted during the present fiscal year.

### CENTER MARKET ACT (41 Stat. 1441).

Assistance was given the Bureau of Agricultural Economics in the revision of the regulations governing, and the forms of leases, permits, etc., used in the administration of Center Market.

Assistance was rendered the United States attorney for the District of Columbia in successfully defending suits filed by one of the tenants in Center Market to enjoin department officials from terminating his occupancy of a stand in the market. The controversy was finally terminated by the dispossession of the tenant under landlord-and-tenant proceedings instituted in the municipal court of the District of Columbia.

## COLLECTION AND DISTRIBUTION OF EXCESS PROFITS ON WOOL CLIP OF 1918.

In the spring of 1918, the need of the armed forces for woolen clothing and other equipment, together with a world-wide shortage of wool, made necessary the taking over of the entire domestic clip of that year and the regulation by the War Industries Board of the handling of the wool by dealers. The regulations required all dealers to be licensed by the board and provided that any profits made in excess of those permitted by the regulations should be disposed of as the Government might decide.

Upon the dissolution of the War Industries Board on December 31, 1918, the President devolved upon the Bureau of Markets of this department the duties of the board respecting the controlled clip. Thereafter, Congress directed that such excess profits should be disposed of by being paid over to the department and distributed by the department to the growers of the wool. The principal duties of the department in this regard have been, therefore, the ascertainment of the excess profits made by the respective dealers, the collection of such profits, and the distribution of them among the growers.

In an early period of the work, certain dealers developed a determined resistance to the collection by the department of the excess profits, and that spirit spread until more than 50 dealers were involved, most of whom have acted apparently more or less in concert. The attitude of these dealers necessitated the institution of civil actions to recover the excess profits found to have been made by them. Forty such cases have been reported to the Department of Justice and 29 are now pending in 19 Federal judicial districts, the others having been disposed of by judgment and collection or voluntary payment, or, in cases where the defendants were so insolvent as to render collection by legal process impossible, by compromise. Preliminary to the institution of suits, this office prepared a very exhaustive memorandum on the legal authority of the War Industries Board to prescribe and enforce the regulations and furnished this to the Department of Justice and the various United States attorneys to whom cases were referred.

The first phase of the dealers' opposition took the form of demurrers questioning the legal existence of the War Industries Board and its authority to control the clip or make regulations in regard thereto, and also the general authority of the United States to maintain the actions. Cases involving those questions have been heard and decided in favor of the Government in seven districts. Three of the cases have been reported—United States *v.* Powers (274 Fed. 131), United States *v.* Smith (285 Fed. 751), and United States *v.* Gordin (287 Fed. 565). In two of the cases this office participated in the oral arguments in the courts. Two others were argued for the Government by the office in cooperation with United States attorneys. In the remaining three, the office prepared the exhaustive briefs which were filed. There were no unfavorable decisions during the year. In one of the cases, a writ of error to the Circuit Court of Appeals is now pending.

Four cases have come to trial upon the merits. In two the facts were stipulated and judgments entered in favor of the Government.

In another there was no contest, but in the remaining case, tried during the closing days of June, there was stubborn resistance. The trial consumed five days, and at its conclusion the jury was discharged and the court has not yet rendered a decision. This case involves the correctness of many of the department's interpretations of the regulations and is a case of first impression in that regard. The trial was conducted for the Government by this office in cooperation with the United States attorney.

The work of this office has consisted chiefly in preparing the cases for the institution of action, including the drafting of pleadings, reporting them to the Department of Justice, preparing an exhaustive brief in support of the Government's contentions as to the validity of the regulations, and supplemental and reply briefs, where necessary, assisting the United States attorneys at the hearings and trials, and acting as a clearing house whereby information of interesting developments in each case is disseminated quickly among all the United States attorneys handling these cases. In short, the office has directed the fight to sustain the action of the War Industries Board and to enforce the regulations.

Assistance was rendered the United States attorney for the District of Columbia in drafting an indictment charging a former auditor of the department and two members of a firm of wool dealers with conspiracy to defraud the United States in the payment by those dealers of a sum of money to the auditor whereby he was induced to make a false audit of their transactions. The two dealers plead guilty and fines aggregating $4,000 were imposed. The auditor is awaiting trial.

## PATENTS.

Thirty-six applications for letters patent on inventions of employees of the department for dedication to the public were prepared and filed. During the year 27 were allowed and 5 disallowed. The following table shows the status of applications on June 30, 1923:

*Patents applied for by members of the department.*

| Applicant. | Bureau. | Invention. | Disposition of application. |
|---|---|---|---|
| Robert G. Merritt | Forest Service | Hypsometer | Allowed. |
| W. G. Taggart | | Decolorizing carbon | Pending in interference. |
| H. D. Gibbs | Chemistry | Sublimation | Allowed. |
| Do | do | Anthracene press cake | Do. |
| E. Q. Adams | do | Sublimation | Do. |
| B. Drummond | Plant Industry | Support for branches of fruit trees | Disallowed. |
| C. R. Smith | Chemistry | Purification of gelatin and glue | Allowed. |
| H. D. Tiemann and R. Thelen | Forest Service | Kiln | Do. |
| A. L. Hein and J. D. MacLean | do | Propeller protractor | Disallowed. |
| M. Phillips and G. H. Mains | Chemistry | Furfural | Allowed. |
| R. L. Parshall | Public Roads | Recording instrument | Do. |
| R. Thelen | Forest Service | Kiln | Pending. |
| R. F. Gardiner | Soils | Soil fertilizer | Do. |
| S. T. Howard | Entomology | Density tester | Allowed. |
| E. W. Schwartze | Chemistry | Poison | Disallowed. |
| H. D. Gibbs | do | Catalyst from vanadium pentoxide. | Allowed. |
| J. S. Bright and L. I. Hewes | Public Roads | Pavements | Pending. |
| L. A. Rogers | Animal Industry | Milk | Disallowed. |
| L. G. Polhamus | Plant Industry | Delinting cottonseed | Allowed. |
| G. F. Mitchell | Chemistry | Beverage producing substances | Pending. |
| M. Phillips | do | Synthetic thymol | Allowed. |
| L. S. Longenecker | do | Separating rotors | Do. |
| S. Palkin | do | Photographic sensitizing dyes | Do. |

*Patents applied for by members of the department*—Continued.

| Applicant. | Bureau. | Invention. | Disposition of application. |
|---|---|---|---|
| W. H. Ross, C. B. Durgin, and R. M. Jones. | Soils | Phosphoric acid | Allowed. |
| A. C. Morgan, K. B. McKinney, and J. Milam. | Entomology | Powder-dusting machine | Pending. |
| S. Butterman and C. K. Cooperrider. | Forest Service | Waterproof adhesive | Allowed. |
| E. C. Sherrard | do | Ethyl alcohol | Do. |
| J. M. Sherman and E. O. Whittier. | Animal Industry | Purification of propionates | Do. |
| J. M. Sherman and R. H. Shaw | do | Propionic acid | Pending. |
| Do | do | Acceleration of propionic fermentation. | Allowed. |
| R. R. Henley | do | Clarified serum antitoxin | Pending. |
| A. C. Weimar | do | Insecticide | Do. |
| C. Brooks | Plant Industry | Preserving apples | Allowed. |
| K. J. Matheson | Animal Industry | Swiss cheese | Pending. |
| S. P. Baldwin | | Bird-nest box | Disallowed. |
| F. C. Lincoln | Biological Survey | Bird trap | Pending. |
| C. F. Walton | Chemistry | Sirup from cane sugar | Allowed. |
| H. S. Paine and J. Hamilton | do | Fondant | Pending. |
| C. F. Walton and H. S. Paine | do | Maple sirup of high density | Do. |
| Do | do | Maple product | Do. |
| A. C. Lindauer | Forest Service | Blood albumin glue | Allowed. |
| H. S. Paine and F. W. Reynolds | Chemistry | Desugarizing molasses | Pending. |
| T. H. Scheffer and L. K. Couch | Biological Survey | Beaver trap | Do. |
| J. W. Turrentine | Soils | Countercurrent lixiviator | Do. |
| H. C. Gore | Chemistry | Cane sirup | Do. |
| F. B. Power and V. K. Chesnut | do | Synthetic apple oil | Allowed. |
| A. Hermann and C. A. Menzel | Forest Service | Hygrometer | Pending. |
| E. C. Sherrard | do | Stock food | Do. |
| L. G. Carmick | Public Roads | Filler for cracks in concrete roads | Do. |
| E. Johnson | do | Powder sprayer | Allowed. |
| M. E. Dunlap | Forest Service | Controlling humidity of workrooms. | Pending. |
| W. H. Ross and W. Hazen | Soils | Potassium phosphates | Allowed. |
| Do | do | Concentrated fertilizer | Do. |
| J. O. Reed | Chemistry | Pneumatic cleaning nozzle | Do. |
| F. E. Denny | do | Coloring lemons | Pending. |
| L. A. Rogers | Animal Industry | Food product from skimmed milk | Do. |
| G. H. Mains | Chemistry | Varnish and paint remover | Do. |
| W. V. Cruess | | Fruit confections | Do. |
| R. Thelen and H. D. Tiemann | Forest Service | Kiln | Do. |
| H. C. Gore | Chemistry | Maltose product | Do. |
| B. Drummond | Plant Industry | Support for branches of fruit trees | Do. |
| H. C. Gore | Chemistry | Sweet-potato product | Do. |
| R. Thelen | Forest Service | Kiln | Do. |
| B. C. Kadel | Weather Bureau | Rain gauge | Do. |
| H. C. Gore | Chemistry | Diastatic material | Do. |

Interferences were declared by the Patent Office between the applications for letters patent of several employees of this department and applications filed by outside parties. Five of these cases were decided favorably to the department employees and the decision in the other case was favorable to the outside party. Testimony was taken in five of the cases, briefs and other papers were prepared therein, and oral arguments made at the final hearing.

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